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REANALYZING THE PLACE OF NATIONAL DEFENSE IN THE SOVIET ECONOMY--ETC(U)
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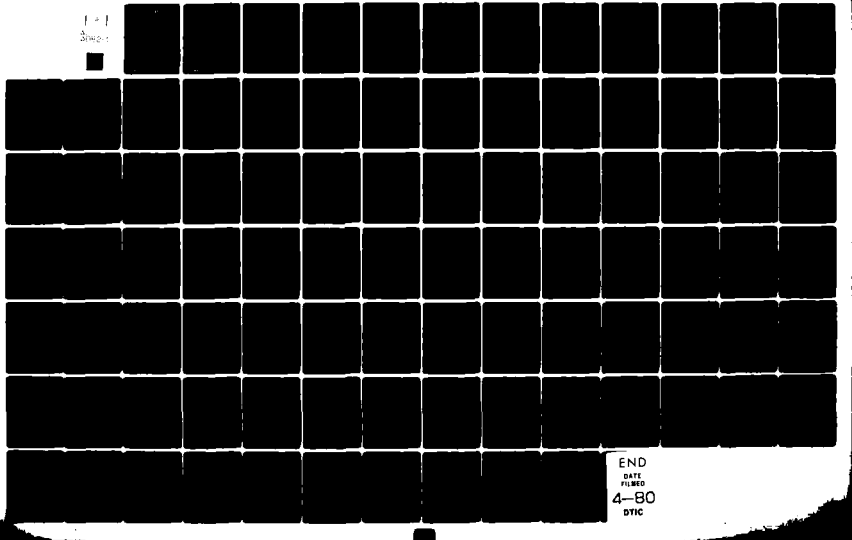

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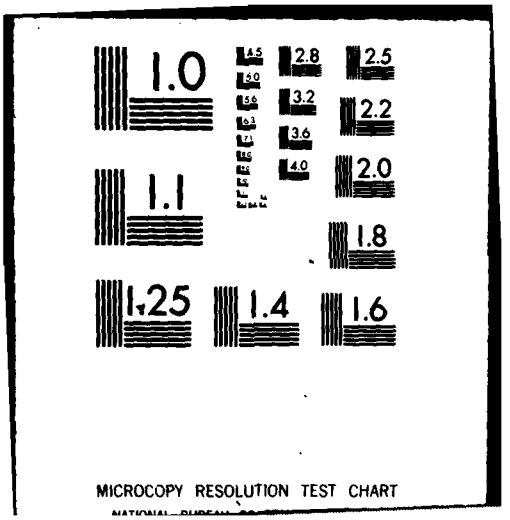
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REANALYZING THE PLACE OF NATIONAL DEFENSE IN THE SOVIET ECONOMY

Final

December 1978

Technical Note
SSC-TN-5790-1

By: Daniel L. Bond
Donald W. Green

Prepared for:

U.S. Arms Control and Disarmament Agency
Washington, D.C. 20451

Contract AC6AC433

SRI Project 5790

SRI International
1611 North Kent Street
Arlington, Virginia 22209

STRATEGIC STUDIES CENTER

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ABSTRACT

This study investigates the relationship between levels of growth in investment and defense expenditures in the USSR for the period covering from the 1950s to 1975 by means of using a single equation econometric estimation. A macroeconometric model of the Soviet economy was then utilized to project Soviet economic performance under various assumed conditions. The study provides information on the repercussion throughout the economy and over an extended time of changes in the level of Soviet defense expenditures.

DISCLAIMER

The views and conclusions contained in this report are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Arms Control and Disarmament Agency.

CONTRACTUAL TASK

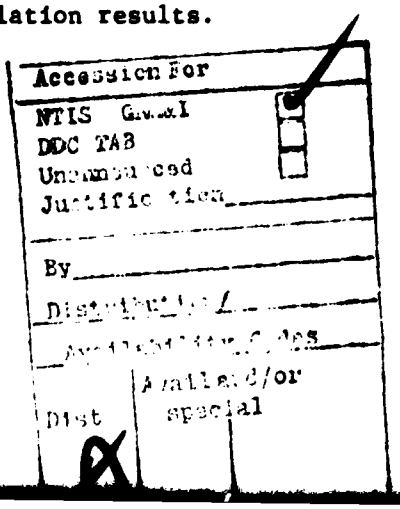
This Technical Note is submitted in partial fulfillment of research under contract AC6AC433, Phase I.

FOREWORD

The investigation into defense expenditure impacts reported upon in this document has proceeded along two lines. The first of these, the results of which are summarized in the first chapter, has been an exploratory study of the relationship between levels of growth in investment and defense expenditures. The method used is single equation econometric estimation applied to data covering the period from the late 1950s to 1975. In these studies various sources of data and forms of relationships have been examined.

The second part of the study reported in Chapter II below is based upon the use of a macroeconometric model of the Soviet economy. This model was built as a tool for projecting the future development of the economy and for analyzing likely changes in that development under alternative domestic and world conditions. Over the past three years, this model has been tested in a number of applications. For this study certain components of the model--those in which defense variables have an important place--have been rebuilt in order to incorporate some of the results of the single equation studies of defense impacts. The revised model was then used to project Soviet economic performance under various assumed conditions. Such studies provide information on the repercussions throughout the economy and over an extended time of changes in the level of Soviet defense expenditures.

Chapter III provides a summary of the econometric evidence and model simulation results.



Richard B. Foster
Director
Strategic Studies Center

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I ECONOMETRIC ANALYSIS OF THE RELATIONSHIP BETWEEN GROWTH IN INVESTMENT AND DEFENSE EXPENDITURES

Introduction

The purpose of this chapter is to summarize the results of two studies of the relationship between growth of investment and defense expenditures in the Soviet economy. More detailed explanations of the analyses and a full description of the results are provided in Working Papers No. 56 and No. 57 attached as appendices to this document. In addition, the implications of these exploratory studies for future econometric work will be briefly discussed.

A. Background on Soviet Defense Estimates

Reliable data on Soviet defense expenditures are not provided in the official Soviet sources. Various techniques have been used by Western analysts to estimate these expenditures. Unfortunately, these techniques provide widely diverging estimates--especially so for the most important component, defense procurement expenditures. The approaches used for estimating this component are of the following types:

- Interpretation and adjustment of published Soviet budget figures so as to reveal defense procurement expenditures concealed under several classifications
- Calculation of the residual of machinery production after nondefense uses are deducted
- Estimating the value of observed defense hardware in dollars via U.S. production analogs and converting these estimates into ruble equivalent values.

Lack of supporting data and disagreement on methodological issues have prevented the reconciliation of results obtained with the various approaches or the determination of a clearly superior one. In this study of defense impacts, estimates for defense procurement obtained in each way have been used. For estimates following the "budgetary approach" Professor Stanley Cohn's figures were used; for the "residuals approach," those of Mr. William T. Lee; and the Office of Strategic Research provided the "direct costing" estimates. (The results of the study based on O.S.R. data are to be reported in a classified supplement.)

Two major categories of defense expenditures were used in the study of investment impacts--procurement expenditures and operations and maintenance (O&M) expenditures. For the former, as noted above, alternative estimated series were used. For O&M expenditures only one estimated series was used since there are not significant differences in these estimates produced by various analysts. The Cohn O&M series was chosen for the study. It was expected that these two categories of defense expenditures would have different impacts on investment.

The procurement category is defined as the expenditures for machinery and equipment used for national defense purposes. It is sometimes referred to as armaments or defense durables. O&M expenditures cover all non-personnel operating costs, thus including the cost of spare parts, equipment installation, utilities, fuel, maintenance of facilities, and transportation. The remaining categories of the Soviet defense budget are personnel and research and development expenditures. These latter categories were not included in the study of investment impacts since their ties to investment were assumed to be insignificant (in the case of personnel expenditures) or very complex (in the case of R&D). Also, the available estimates for these categories are not very reliable or informative.

B. Approach of the Study

In the study of defense expenditure impacts on the Soviet economy, most analysts have stressed the trade-off between increases in the level of defense expenditures on one hand and the rate of growth of investment, consumption, and gross national product on the other hand. Those economists who have attempted to quantify these relationships have usually done so by applying production function analysis directly to the determination of changes in output after assuming the trade-off that occurs between civilian investment (in both producer and consumer durables) and military procurement. Such an approach is a useful first step, which can lead to an understanding of the possible degree of impact. It suffers, however, from the reliance that must be placed on the initial assumptions.

Since the Soviet economy is typically assumed to be operating at full capacity output, the usual assumption is that the trade-off between military and nonmilitary uses of investment goods is carried out on a one-to-one basis. This need not be so for a number of reasons and should be considered an empirical question. Production capacity used for military durables may not be easily convertible to civilian uses. Productivity in producing arms and producer durables could be considerably different. These would be two of the factors influencing the trade-off rates between investment and defense procurement levels.

An attempt was made in the present study to estimate the trade-off empirically. Using time series data for the Soviet economy covering the past twenty years, a number of relationships between defense and investment variables were analyzed using single equation econometric techniques. Selected results of this step were then incorporated into an already existing macroeconometric model of the Soviet economy in order to evaluate the indirect and dynamic implications of these estimated relationships.

The most difficult and critical aspect of such a study is the proper specification of the relationship between dependent and explanatory variables.

In order to have some confidence in both the specification used and the parameters estimated, detailed studies of investment equations were carried out using various categories of investment (some of which are not represented in the model) and alternative formulations of the defense expenditures variables. Lacking much theoretical guidance in this process, the search for useful specifications was guided by some descriptive knowledge of the economy and its history, and the results of the econometric testing.

C. Estimation of Defense Impacts

It is reasonable to take as a starting point the proposition that the use of industrial capacity for producing military hardware will to some extent restrain the production of producer and consumer durables. This in turn constrains investment and consumption in the present and GNP growth in the future. This standard view shaped the original choice of a specification for the defense impacts.

In the investment equations tested, the dependent variable--investment of a given type--is given in growth rate form. Expenditures for defense O&M were also specified in this way, or in some cases the growth rate was smoothed with the previous year's value. In the case of the Cohn series for defense procurement, the variable is given as a ratio to an index of machine-building and metal-working output (averaged with the previous year's values). This was done to separate the direct effect of changes in MBMW production on investment from the effect of defense procurements (themselves purchases of MBMW products) on investment.

The full results of the estimations made using this specification with the Cohn data are reported in Working Paper No. 56. A select few of the results are summarized in the following table. (Not included in this table are the coefficients obtained for the additional explanatory variables--growth of profits, the five-year plan cycle, the planned rate of growth of centralized investment, and construction finishing campaigns. Results for these can be found in the original paper.)

Table 1

INVESTMENT EQUATION COEFFICIENTS FOR DEFENSE EXPENDITURE VARIABLES

Investment Category	Equation	Defense O&M Cohn Estimates	Defense Procurement Cohn Estimates	Defense Procurement Lee Estimates Shift	Defense Procurement Lee Estimates Planned
Total new capital investment	Cohn	-0.086	-0.152		
	Lee	-0.081		-0.153	+0.131
Total construction - installation work	Cohn	-0.082	-0.167		
	Lee	-0.069			+0.131
Total machinery and equipment investment	Cohn		-0.446		
	Lee			-0.281	
Total centralized investment	Cohn		-0.301		
	Lee			-0.143	+0.080
Centralized construction - installation work	Cohn		-0.347		
	Lee				+0.121
Centralized machinery and other investment	Cohn		-0.211		
	Lee			-0.294	

Only the equations for total and centralized investment and their components for construction-installation work and machinery and equipmemt investment are summarized here. These are the most pertinent for the analysis of defense impacts since centralized investment (which accounts for over three-fourths of total investment) includes all investment requiring ministry approval, and thus all defense sector investment (although defense spending does have some interesting impacts on decentralized investment).

The coefficient signs of all the defense variables in these estimations are negative--indicating the expected trade-off between defense expenditures and investment. Static multipliers were calculated from these results and are presented in the next table. These indicate rather low trade-off rates between defense expenditures (especially those for procurement) and investment. For example, with the equations using the Cohn data, a one ruble increase in defense O&M is indicated to result in a 0.575 ruble decrease in total investment, while an equal increase in defense procurement leads to only a 0.112 ruble decrease in investment.

Using these same initial specifications, the investment equations were reestimated using the Lee series for defense procurement in place of the Cohn series. In all cases the procurement variable proved to be insignificant (based on the t-test statistics) in helping to explain the growth of investment. (This is not a surprising econometric result as the Cohn and Lee estimates for procurement are very different in both their levels and patterns of change over the historic period.) However, the Lee series did give significant results when tested under an alternative specification of defense impacts. As is argued in Working Paper No. 57, any observed trade-off between procurement and investment should, at least in theory, be minimal in a centrally-planned economy under normal conditions if planned increases in defense levels have been properly incorporated into the investment plans. If an arms build-up, for example, is planned in some future period, then appropriate additional investment in the machine-building branches should be provided with sufficient lead time to insure

Table 2

STATIC INVESTMENT MULTIPLIERS FOR DEFENSE EXPENDITURES

Investment Category	Equation	Defense O&M	Defense Procurement		
		Cohn Estimates	Cohn Estimates	Lee Estimates	
				Shift	Planned
Total new capital investment	Cohn	-0.575	-0.112		
	Lee	-0.542		-0.781	-0.319
Total construction - installation work	Cohn	-0.173	-0.076		
	Lee	-0.285			-0.196
Total machinery and equipment investment	Cohn		-0.100		
	Lee			-0.440	
Total centralized investment	Cohn		-0.157		
	Lee			-0.518	-0.138
Centralized construction - installation work	Cohn		-0.109		
	Lee				-0.125
Centralized machinery and other investment	Cohn		-0.044		
	Lee			-0.429	

that both future civilian and military needs for durables can be met. It would be desirable, therefore, to include in the investment equations as an explanatory variable planned future defense procurement. Since Soviet defense plans are not made public, it was necessary to use a surrogate measure based on realized levels of defense. This "planned procurement" variable was specified as a smoothed three-year growth rate of estimated defense procurement expenditures.

Most of the increase in capacity required for greater armament production will be in machine building and its suppliers. Thus it is expected that the "planned procurement" variable will have coefficients of positive sign in investment equations for these branches. In order to create this additional capacity, resources must be diverted from other uses--either by allocating to the machine-building branches some investment that would have gone into other branches, or by increasing the level of total investment at the expense of other categories of end-use, such as consumption. Thus, in investment equations for some branches, it is to be expected that the coefficient for "planned procurement" will have a negative sign; while for total investment, the sign will be positive.

If short-falls in plan investment fulfillment are encountered, if the plan is faulty, or if a crisis situation occurs requiring unplanned arms increases, then some displacement of competing civilian needs will occur. A second procurement variable, labeled the "procurement shift" variable, was designed as a crude measure of the latter occasion. On the assumption that defense growth is relatively smooth except in crisis situations, this variable was expressed as the difference between the rate of growth of procurement in the current year and the previous year. Since the "shift" variable is expected to indicate periods when current trade-offs are required, negative signs are expected for its coefficients.

Some results obtained with Lee data in these specifications are included in Table 1. (The full results are given in Working Paper No. 57.) The estimated coefficients were generally significant, with the appropriate signs. Overall equation fits were as good as those obtained in the first set of estimations using the Cohn series for procurement.

The static multipliers calculated from these results show a significantly higher level of impact on investment than those obtained in the first set, as can be seen in Table 2. (The static multiplier gives the amount of change in investment that would result from a unit increase in defense procurement made during the current period.) Because of the form of the specification used for the "planned procurement" variable, its static multiplier is not very informative. The sign is negative since an increase in present procurement, all other conditions remaining constant, implies in a relative sense lower rate of growth of future procurement and thus a reduced need for investment in the current period. An equal increase in some future year would, however, have a positive impact on current investment growth.

D. Evaluation of the Estimation Results

The estimations carried out with the Cohn and Lee defense expenditures series indicate fairly clearly that the current period trade-off between defense procurement and investment is not on a simple one-to-one basis. In a dynamic framework, however, the situation is more complicated. As was indicated by the results when using the "planned procurement" variable, it may be that future armament needs are carefully planned, with production capacity increases occuring in sufficient time to minimize current period trade-offs. If this is the case, then the observed magnitudes of impact over the historic period may be misleading. Supportive of this view are the multipliers calculated for the "procurement shift" variable. It was suggested above that this variable served as a crude indicator of sudden changes in the level of procurement that would be likely to occur in crisis situations. The increases realized on such occasions would not have been planned and so would require a displacement of non-defense investment.

The multipliers given for the "shift" variable in Table 2 are considerably larger than multipliers for other procurement variables. For example, they indicate a one ruble increase in procurement of military durables would lead to a 0.781 ruble decrease in total investment.

In evaluating the trade-offs involved in increased defense levels, it seems that the time dimension considered is of critical importance. If only the current period is considered, no significant trade-off between defense expenditures and investment may be observed since capacity of the investment goods sectors in theory is planned so as to cover both defense and nondefense needs. But if full capacity utilization is assumed, there must be a trade-off at some point. What has been suggested is that this trade-off occurs during earlier periods when investment is diverted to the machine-building branches from other sectors for the purpose of increasing capacity for use in arms production. And when at the aggregate level, there is a diversion of output from consumption and other end-users into investment as a second impact.

The decision to commit resources to expanding productive capacity for defense uses is the critical decision. And this decision is made several years prior to the appearance of the arms themselves. The current period coincidence of increased defense procurement and decreased investment may be only the result of unanticipated difficulties in plan fulfillment or crisis situations. An evaluation of the "burden" of defense should pay more attention to the former.

Finally, the results of this portion of the study show that both the Cohn or Lee procurement estimates have significance in explanatory variables for investment equations. It should be stressed that these findings do not validate either set of estimates. However, they do make it possible to examine the implications of using either of the series, as was done above, and the specifications developed can be incorporated into investment equations of the macroeconometric model for simulation studies. The results of such studies are discussed in the next chapter.

E. Suggestions for Further Research

Some ideas for futher research can be drawn from the results obtained to date. First, it will be necessary to determine which approach to the estimation of defense procurement levels seems most useful for econometric analysis and modeling. Having obtained some explanatory power from two very divergent series, one might ask how this is possible. Given the very few observations used in the econometric analysis the relationships revealed may be spurious. On the other hand, both series are measures reflecting some form of economic activity in the Soviet Union--one a not fully-explained category of budget allocations, the other a not-fully explained residual category of use of durables production--which seem to move in patterns having a relationship to movement in investment. This relationship may be real, and even causal, while neither series may be an acceptable measure of defense procurement. In choosing a final series of numbers to call, and use as, defense procurement, one should consider both the reasonableness of the reconstruction technique applied and the explanatory power the series has as a part of a system of economic indicators. With such an objective in mind a number of additional econometric studies would be in order.

Second, the distinction between current and permanent trade-offs between defense procurement and other investment should be more thoroughly investigated. The current impacts are of use in understanding certain short-term fluctuations in investment patterns. However, for purposes of measuring the burden of defense on the Soviet economy, it is the permanent trade-offs which are most significant. The specification of the relationship between defense expenditures and investment that involves the "planned procurement" variable argues that it is not in lowered levels of investment that indicators of the "burden of defense" are to be sought. Rather, it is in the rapid growth of industrial investment, centered in the machine-building complex, needed to support Soviet military arms production, that the division of resources has occurred and the burden rests.

Third, a careful study of direct links between defense variables and economic variables other than investment may be useful. Some initial results along this line are reported in Working Paper No. 57. Especially important may be the relationship between increased levels of defense spending and increased productivity growth of certain industrial sectors and changes in the volume of imports of machinery and equipment.

II MACROECONOMETRIC MODEL SIMULATION STUDIES OF DEFENSE EXPENDITURE IMPACTS

Introduction

In this chapter the major results of a series of simulation studies of defense expenditure impacts carried out with the aid of a macroeconometric model of the Soviet economy will be summarized. This model has been tested in a number of application studies of various types, and has been proven to be a valuable tool for analyzing the response of the Soviet economy under various conditions. By applying the existing model, with some limited changes in sectors containing defense variables, to the analysis of defense expenditure impacts, it has been possible to obtain some quantitative measure of their significance as these impacts spread throughout various parts of the economy and over time. This initial study provides a basis for suggesting further avenues of development of the model, which are mentioned at the end of the chapter.

A. Description of the Defense Components of the Model

In order to examine the full impact of defense expenditures on the Soviet economy, the results of the investment study (summarized in Chapter I) were used in the rebuilding of certain components of the macroeconometric model. The existing structure of the model did not allow the incorporation of the full range of these results, however. For example, although the disaggregation of investment by type of administrative control (centralized versus decentralized) and producing sector (machinery and equipment versus construction and installation work) is central to the previous analysis, this distinction is not found in the model. These subcategories of investment play no role in the existing system of equations, so without extensive restructuring of the model they could not be incorporated into it. On the other hand, the equations for the detailed disaggregation of investment by purchasing branch which appear in the

model were reestimated with both the Cohn and Lee data. It is here that the lessons of the previous exercise were used. The specifications developed in the single equation studies were carried over into a number of the investment equations of the macromodel. In the version of the model used, switches were introduced into the solution programming which allow the choice of either the investment equations estimated with Cohn procurement expenditures variables or the alternatively-specified investment equations estimated with the Lee procurement variables. In the following discussion the solutions obtained with the model will be identified according to which of these sets of equations was used.

In the consumption equations of the model the Cohn defense operations and maintenance (O&M) data were used to estimate the impact of changes in the rate of growth of this defense variable (given as a ratio to an index of growth for machine-building and metal-working output). Other conditions being constant, an increase in defense O&M expenditures results in a shift in the structure of consumption away from consumer durables and toward a greater share of softgoods, food and services consumption.

The direct entry of defense variables into other sectors of the model is purely an accounting process. Military personnel expenditures are defined as a category of production valued at cost, and thus are included in the GNP aggregates. As a source of household income they are added to that category also, when GNP is measured from the income approach.

It is through indirect links via the investment equations that defense expenditure impacts spread throughout the model. Certain blocks of the model, such as the foreign trade block, contain no defense variables directly in its component equations. The solution values of the endogenous variables in these components, however, are affected by the changes in indicators of overall economic activity generated by changes in the level of defense expenditures.

B. Defense Expenditure Simulation Multipliers

In order to isolate the separate impact of defense procurement and O&M expenditures, simulation multipliers were computed after solving the model over the 1976-1985 projection period four times. In the first two runs, procurement expenditures were increased by one billion rubles over their projected baseline values each year for the entire time period.* In one run "Cohn equations" were used; in the second, "Lee equations." The same procedure was repeated with increases in the O&M category, in the other two equations.

The results of these simulations are summarized in Table 3. For GNP, consumption, and investment the difference between the appropriate baseline projection and the various projections with defense expenditure increases are given for 1980 and 1985. The most significant result is the positive impact on investment, and through investment on GNP, of an increase in procurement when the Lee version is used, as contrasted to the negative impacts when the Cohn equations are used. Since the rate of growth of defense procurement is, by assumption, steady in all projections, the Lee "procurement shift" variable has no impact. Thus the difference reduces to the contrast between the current period trade-off of investment and defense captured in the Cohn equations and the complementary increases in current investment and future defense procurement expressed in the Lee equations. As in our previous results, the degree of the impact derived from the Lee estimates is significantly greater than that with the Cohn.

In both simulations with increases in O&M expenditures, the impacts are similar both in degree and direction. This was to be expected since the definition of this defense variable is the same in both sets of investment equations--only the estimated coefficients differing to some degree.

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* The baseline assumptions are described in the next section.

Table 3

MODEL SIMULATION IMPACTS OF A ONE BILLION RUBLE INCREASE IN DEFENSE EXPENDITURE CATEGORIES

Version:	Category of Defense Spending Indicators	Impact in Billions of 1970 Rubles 1980	1985
Cohn:	Procurement		
	GNP	-0.121	-0.605
	Consumption	+0.150	+0.213
	Investment	-0.280	-0.709
Lee:	Procurement		
	GNP	+0.481	+2.793
	Consumption	-0.500	+0.690
	Investment	+0.917	+0.955
Cohn:	Operations and Maintenance		
	GNP	-0.845	-1.789
	Consumption	-0.217	-0.751
	Investment	-1.567	-1.848
Lee:	Operations and Maintenance		
	GNP	-1.016	-0.545
	Consumption	-0.327	-0.447
	Investment	-1.575	-1.681

In all cases the impact on consumption is determined by the direction and degree of change in GNP and investment. In the model total consumption is determined as a residual end-use category. Thus if investment changes to a greater degree than GNP, the change in consumption will be of the opposite sign to the change in investment. Likewise, if investment changes to a lesser degree, the signs of the two will be the same.

Comparison of the magnitudes of the 1980 impacts with those of 1985 show that the full impact of defense expenditure increases in the model are realized over a number of years. There are two sources for this effect. First, the specifications of the procurement variables, both Lee and Cohn, create a direct impact on investment levels of more than a single year's duration. Second, the indirect impacts created by lower or higher investment rates require a number of solution periods to work their way throughout the model. (This corresponds to the time required in the real economy for investment to be converted into capital stock, which then is used in production.) In the case of the Lee version, this time effect is especially significant since it creates a reduction in consumption initially, but an increase in the long-run.

C. Scenario Studies of Defense Expenditure Impacts

For a more complete portrayal of the influence of defense expenditures on the Soviet economy, a set of scenarios was designed to depict the impact of significantly different future levels of defense spending under various conditions of the domestic and foreign economic scene. A total of twelve projections of Soviet economic development over the period 1976-1985 was then prepared using the macroeconometric model. These projections incorporate all the various combinations of initial conditions and defense expenditures changes using alternately the Cohn and Lee versions of the investment equations. First the various scenario dimensions will be described; then the simulation results will be summarized.

Two baseline projections were prepared for the analysis. One has been labeled "favorable conditions" since the assumptions for the exogenous variables for weather and world trade conditions are somewhat better than average, based on the experience of the past decade. The second contains assumptions typifying "unfavorable conditions." Rainfall and temperature are set at the average values observed over the period 1959-1965, a period of poor harvests. Western imports of Soviet goods are projected to grow at only five percent per year, rather than the seven percent assumed in the baseline for favorable conditions. Also, in comparison with favorable conditions, grain imports are placed at higher levels (an assumed necessary consequence of bad weather) and grain prices rise faster. Price increases for Soviet exports of gold, fuels and raw materials are assumed to grow slower.

For the projections with increased defense expenditures, defense procurement was projected to grow at an annual rate of 12 percent and O&M at four and one-half percent in comparison with the three percent growth for both categories taken in the baseline.

Defense expenditure decrease assumptions were designed to reflect the levels that would be realized in an across-the-board cut of 10 percent in all categories realized over a four year period starting in 1977. The reduced level of expenditures was then held constant from 1980 to 1985.

In the following tables the scenario results are summarized for major domestic and foreign trade solution variables. Historic 1975 values are given together with 1980 and 1985 projections for each scenario design. The results obtained when the model was simulated using Cohn equations are given in Table 4; those with the Lee equations in Table 5.

When comparing the impact of defense expenditure changes in the various solutions, one should keep in mind the following. The model used here is basically a linear model. This means that the degree of response to an equal increase or decrease in an exogenous variable should be

Table 4

LINE	ITEM	1975	PROJECTIONS USING COIN EQUATIONS: FAVORABLE CONDITIONS, BASELINE 1980	FAVORABLE CONDITIONS, DEFENSE EXPENDITURES: INCREASE 1980	FAVORABLE CONDITIONS, DEFENSE EXPENDITURES: DECREASE 1980	UNFAVORABLE CONDITIONS, BASELINE 1980	UNFAVORABLE CONDITIONS, DEFENSE EXPENDITURES: INCREASE 1980	UNFAVORABLE CONDITIONS, DEFENSE EXPENDITURES: DECREASE 1980
1								
2	DOMESTIC ACTIVITY, B, 1970 RUBLES							
3								
4	GNP,SECTOR-OF-ORIGIN	468,018	584,652	583,786	584,723	577,573	576,826	577,624
5	AGRICULTURE	64,683	75,190	75,139	75,190	70,160	70,111	70,160
6	INDUSTRY	208,585	270,248	269,782	270,309	269,431	269,045	269,477
7								
8	CONSUMPTION	268,928	333,267	333,651	333,119	331,217	331,503	331,078
9	FOOD	125,217	148,056	148,338	147,969	147,671	147,913	147,590
10	SOFT GOODS	54,910	71,542	71,689	71,500	70,515	70,642	70,476
11	DURABLE GOODS	23,324	34,521	34,419	34,501	33,538	33,627	33,519
12	SERVICES	65,478	79,147	79,203	79,142	79,492	79,519	79,492
13								
14	NEW FIXED CAPITAL INVESTMENT	115,095	139,236	136,674	139,579	135,433	133,063	135,746
15	AGRICULTURE	23,659	33,496	33,049	33,496	32,737	32,299	32,737
16	INDUSTRY	40,771	51,404	50,091	51,723	50,857	49,566	51,169
17	MH&MN	9,685	12,993	12,441	13,171	12,658	12,118	12,832
18								
19	REAL DISPOSABLE INCOME	221,854	268,886	268,450	268,937	260,372	260,034	260,407
20								
21								
22	FOREIGN TRADE, M,$US							
23								
24	TOTAL EXPORTS	33140.	53707.	53674.	53710.	53539.	53518.	53542.
25	TOTAL IMPORTS	36942.	53404.	53269.	53429.	52967.	52840.	52990.
26	NET EXPORTS	-3802.	303.	405.	281.	573.	673.	552.
27								
28	NET EXPORTS TO:							
29	CMEA	386.	799.	789.	803.	886.	880.	889.
30	OTHER SOCIALIST COUNTRIES	84.	312.	312.	312.	312.	312.	312.
31	DEVELOPED WEST	-5034.	-1521.	-1452.	-1534.	-1369.	-1302.	-1381.
32	DEVELOPING COUNTRIES	-1142.	-474.	-474.	-474.	-417.	-417.	-417.
33								
34	HARD CURRENCY BALANCE	-1594.	2130.	2286.	2109.	3332.	3460.	3315.
35	HARD CURRENCY DEBT	7489.	16951.	16951.	16951.	17869.	17869.	17869.
36	DEBT SERVICE RATIO	0.188	0.337	0.338	0.337	0.354	0.358	0.354

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Table 4 (Concluded)

LINE	ITEM	PROJECTIONS USING COHN EQUATIONS					
		FAVORABLE CONDITIONS			UNFAVORABLE CONDITIONS		
			DEFENSE EXPENDITURES:			DEFENSE EXPENDITURES:	
		BASELINE	INCREASE	DECREASE	BASELINE	INCREASE	DECREASE
		1985	1985	1985	1985	1985	1985
1							
2	DOMESTIC ACTIVITY, B. 1970 RUBLES						
3							
4	GNP,SECTOR-OF-ORIGIN	716,248	711,308	717,273	704,520	699,876	705,479
5	AGRICULTURE	80,659	80,492	80,656	73,496	73,341	73,493
6	INDUSTRY	343,484	340,219	344,391	341,400	338,332	342,256
7							
8	CONSUMPTION	407,274	408,667	406,417	403,043	404,352	402,197
9	FOOD	174,787	175,748	174,305	175,300	176,234	174,814
10	SOFT GOODS	90,500	91,017	90,251	88,157	88,648	87,912
11	DURABLE GOODS	47,875	47,771	47,747	45,234	45,115	45,113
12	SERVICES	94,109	94,126	94,110	94,349	94,351	94,358
13							
14	NEW FIXED CAPITAL INVESTMENT	175,483	167,120	177,370	168,482	160,588	170,259
15	AGRICULTURE	47,710	46,624	47,710	45,716	44,672	45,716
16	INDUSTRY	65,264	59,383	67,140	63,525	57,931	65,309
17	MB&MW	16,915	13,819	17,951	15,780	12,862	16,758
18							
19	REAL DISPOSABLE INCOME	331,620	328,879	332,337	316,097	313,658	316,740
20							
21							
22	FOREIGN TRADE, M,$US						
23							
24	TOTAL EXPORTS	84242,	83978,	84310,	82504,	82284,	82560,
25	TOTAL IMPORTS	83483,	82562,	83738,	78289,	77561,	78483,
26	NET EXPORTS	759,	1417,	573,	4215,	4723,	4077,
27							
28	NET EXPORTS TO:						
29	CMEA	1958,	1905,	1990,	2206,	2158,	2237,
30	OTHER SOCIALIST COUNTRIES	678,	678,	678,	678,	678,	678,
31	DEVELOPED WEST	-3434,	-2885,	-3600,	-546,	-114,	-675,
32	DEVELOPING COUNTRIES	-367,	-367,	-367,	-167,	-167,	-167,
33							
34	HARD CURRENCY BALANCE	-212,	1299,	-619,	12722,	13973,	12390,
35	HARD CURRENCY DEBT	22257,	22257,	22257,	26008,	26008,	26008,
36	DEBT SERVICE RATIO	0,348	0,352	0,347	0,426	0,430	0,425

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Table 5

LINE	ITEM	1975	PROJECTIONS USING LEE EQUATIONS: FAVORABLE CONDITIONS, BASELINE 1980	FAVORABLE CONDITIONS, DEFENSE EXPENDITURES: INCREASE 1980	FAVORABLE CONDITIONS, DEFENSE EXPENDITURES: DECREASE 1980	UNFAVORABLE CONDITIONS, BASELINE 1980	UNFAVORABLE CONDITIONS, DEFENSE EXPENDITURES: INCREASE 1980	UNFAVORABLE CONDITIONS, DEFENSE EXPENDITURES: DECREASE 1980
1								
2	DOMESTIC ACTIVITY, B, 1970 RUBLES							
3								
4	GNP,SECTOR-OF-ORIGIN	468,018	581,711	581,461	581,524	574,736	574,744	574,616
5	AGRICULTURE	64,683	75,207	75,146	75,207	70,166	70,117	70,166
6	INDUSTRY	208,585	267,694	267,791	267,535	266,939	267,229	266,810
7								
8	CONSUMPTION	268,928	335,372	334,612	335,640	333,124	332,263	333,338
9	FOOD	125,217	149,259	148,852	149,405	148,774	148,345	148,900
10	SOFT GOODS	54,910	72,113	71,929	72,184	71,032	70,839	71,092
11	DURABLE GOODS	23,324	34,779	34,518	34,812	33,766	33,505	33,794
12	SERVICES	65,478	79,219	79,311	79,238	79,550	79,572	79,550
13								
14	NEW FIXED CAPITAL INVESTMENT	115,095	135,225	134,783	134,737	131,647	131,565	131,258
15	AGRICULTURE	23,659	33,496	33,049	33,496	32,737	32,299	32,737
16	INDUSTRY	40,771	47,782	48,762	47,387	47,364	48,332	46,976
17	MB&MN	9,685	10,196	11,452	9,762	10,001	11,240	9,573
18								
19	REAL DISPOSABLE INCOME	221,854	266,862	266,801	266,722	258,428	258,609	258,346
20								
21								
22	FOREIGN TRADE, M,$US							
23								
24	TOTAL EXPORTS	33140,	53609,	53596,	53603,	53449,	53448,	53446,
25	TOTAL IMPORTS	36942,	53154,	53084,	53119,	52625,	52677,	52595,
26	NET EXPORTS	-3802,	455,	512,	484,	825,	771,	851,
27								
28	NET EXPORTS TO:							
29	CMEA	386,	714,	746,	706,	780,	805,	775,
30	OTHER SOCIALIST COUNTRIES	84,	312,	312,	312,	312,	312,	312,
31	DEVELOPED WEST	-5034,	-1351,	-1293,	-1326,	-1105,	-1157,	-1084,
32	DEVELOPING COUNTRIES	-1142,	-474,	-474,	-474,	-417,	-417,	-417,
33								
34	HARD CURRENCY BALANCE	-1594,	2716,	2813,	2763,	3989,	3922,	4019,
35	HARD CURRENCY DEBT	7489,	16951,	16951,	16951,	17869,	17869,	17869,
36	DEBT SERVICE RATIO	0,188	0,339	0,340	0,340	0,356	0,356	0,356

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Table 5 (Concluded)

LINE	ITEM	PROJECTIONS USING LEE EQUATIONS					
		FAVORABLE CONDITIONS			UNFAVORABLE CONDITIONS		
			DEFENSE EXPENDITURES:			DEFENSE EXPENDITURES:	
		BASELINE 1985	INCREASE 1985	DECREASE 1985	BASELINE 1985	INCREASE 1985	DECREASE 1985
1							
2	DOMESTIC ACTIVITY, B, 1970 RUBLES						
3							
4	GNP,SECTOR-OF-ORIGIN	704,163	707,029	702,363	693,052	696,259	691,393
5	AGRICULTURE	80,732	80,527	80,738	73,551	73,372	73,556
6	INDUSTRY	332,741	336,577	331,129	331,173	335,171	329,660
7							
8	CONSUMPTION	405,916	405,049	405,536	401,562	400,737	401,205
9	FOOD	174,095	173,732	173,896	174,519	174,199	174,324
10	SOFT GOODS	90,131	89,962	90,029	87,758	87,614	87,657
11	DURABLE GOODS	47,617	47,190	47,553	44,968	44,565	44,909
12	SERVICES	94,069	94,160	94,075	94,319	94,355	94,311
13							
14	NEW FIXED CAPITAL INVESTMENT	168,191	168,052	167,603	161,937	161,966	161,480
15	AGRICULTURE	47,710	46,624	47,710	45,716	44,672	45,716
16	INDUSTRY	58,194	60,719	57,669	57,129	59,479	56,667
17	MM$/MW	10,300	14,390	8,990	9,815	13,756	8,558
18							
19	REAL DISPOSABLE INCOME	323,068	325,832	321,776	308,278	311,160	307,140
20							
21							
22	FOREIGN TRADE, M,$US						
23							
24	TOTAL EXPORTS	83647,	83756,	83589,	81983,	82101,	81939,
25	TOTAL IMPORTS	81713,	82181,	81525,	76832,	77231,	76684,
26	NET EXPORTS	1934,	1575,	2064,	5151,	4869,	5255,
27							
28	NET EXPORTS TO:						
29	CMEA	1942,	2002,	1943,	2198,	2256,	2199,
30	OTHER SOCIALIST COUNTRIES	678,	678,	678,	678,	678,	678,
31	DEVELOPED WEST	-2373,	-2746,	-2245,	299,	-8,	400,
32	DEVELOPING COUNTRIES	-367,	-367,	-367,	-167,	-167,	-167,
33							
34	HARD CURRENCY BALANCE	3478,	2582,	3889,	15948,	15042,	16280,
35	HARD CURRENCY DEBT	22257,	22257,	22257,	26008,	26008,	26008,
36	DEBT SERVICE RATIO	0,358	0,356	0,359	0,438	0,435	0,439

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roughly the same. This is one reason why equal degrees of increase and decrease in defense expenditures were not used for the scenario designs--the results would have been redundant. The rate of growth of defense spending chosen for analysis is the upper limit considered likely over the next few years. The level of defense cuts are intended to correspond to those put forth by the Soviets at various times in the past (10-15 percent) (that the cuts would be equal in all categories was taken for simplicity).

The following comparisons between the Cohn and Lee projections may be noted:

- The rate of growth of the Soviet economy over the future projection period is significantly slower when the Lee equations are used, even for the baseline conditions. This is the result of the significantly higher rate of growth of the Lee procurement estimates over the historic period than is assumed for the baseline projections. The baseline three percent growth rate for defense is comparable only to the past increases estimated by Cohn. As a result, the projection of future investment levels and overall growth more closely follow an extension of past trends when the Cohn equations are used, but are lowered with the Lee version.

- In keeping with our previous results, the response to defense expenditure changes when using the Lee equations is opposite in direction to that obtained with the Cohn version for most solution values.

- The deviations from the baselines produced under the defense spending alternatives are less pronounced in all cases than the deviations caused by the assumptions of "unfavorable conditions." For instance, the largest deviation from a baseline value for GNP is 5 billion rubles. This can be compared to the 12 billion ruble difference in GNP between baseline projections for 1985 for favorable and unfavorable conditions. However, for some disaggregated categories the differences generated under alternative defense scenarios is much greater than this. Investment in the machine-building and metal-working (MB&MW) industry increases by approximately 40 percent in 1985 with defense expenditure increases when the Lee equations are used.

- As stated above the foreign trade responses are not a direct result of the changes in defense expenditures. Rather they reflect changes in output of branches of industry. For example, the exports of fuels to the Developed West are determined in the model partially as a function of the difference in the rate of growth of the output of the petroleum products branch and the rate of growth of total industry. (This specification was designed to indicate the availability of fuels for export.) As defense expenditures change the relative growth of these outputs, fuel exports will vary. As can be seen in the tables, the influence of the defense assumptions is weak when compared with the large foreign trade changes caused by the difference between favorable and unfavorable baseline conditions.

D. Suggestions for Further Research

It will require considerably more experience in applying the macro-econometric model to defense expenditures impact analysis before it will be possible to place confidence in the results obtained in its use. Further development work in the structuring of the model for this specific purpose would also seem to be required. The incorporation of balancing equations of the input-output type are necessary to tie together various components of the model and to maintain consistency in the movements of its sectors. Defense variables should be introduced into the foreign trade and production equations. The incorporation of the distinction between investment in machinery and equipment and investment in construction-installation work, which was found to have significance in the study reported in the first chapter, may be useful in the model also. Such changes, together with continued application of the model by its builders, and critical appraisals of the results obtained by experts in Soviet defense analysis, may eventually lead to the creation of a powerful and useful tool. The research reported here is but a first step in that direction.

III THE IMPACT OF DEFENSE EXPENDITURES ON THE SOVIET ECONOMY: A SUMMARY OF ECONOMETRIC EVIDENCE AND MODEL SIMULATION RESULTS

A. The Principle Features of the Present Study

The major contributions of the present research effort include the following:

- A new categorization of capital investment activity designed to clarify the impacts of Soviet defense expenditures on capital accumulation
- A revision of SOVMOD III, the third generation SRI-WEFA Soviet Econometric Model, based upon Stanley Cohn's estimates of defense operating and maintenance expenditures and military procurement
- A parallel estimation of defense impacts for the Soviet Econometric Model of the Office of Economic Research (SEMOER) based upon estimates provided by the Office of Strategic Research (CIA)
- Development of an alternative specification of defense impacts using William Lee's estimates of Soviet military procurement and the programming of an alternative version of SOVMOD III based upon those impacts
- A comparison of those alternative estimates and specifications through the simulation of the macroeconometric model, SOVMOD III.

In the next section of this chapter, we will review the comparison of econometric and simulation results, indicating where conclusions are relatively firm and where firm conclusions would appear to be still premature. In the final sections of the chapter, the implications of this study for future refinement of model structure and defense estimates will be briefly discussed.

B. Review of Estimation and Simulation Results

1. Operating and Maintenance Expenditures

The new categorization used for capital investment has definitely improved our understanding of the impact of nonpersonnel expenditures derived by Cohn from the official Soviet defense budget. The inverse response of capital investment to this defense variable was shown to derive from the decentralized categories of capital investment, and the impact was greater upon construction-installation work than in machinery. Consequently, this short-run substitution effect may arise from priority demand for fuels, construction materials and spare parts used in the military and defense industries. This set of defense impacts on various categories of capital investment is similar for both Cohn and Lee versions of SOVMOD III.

There remains a specification problem, however, with this category of defense expenditure: The long-term consequence of a shift in the growth rate of operating and maintenance expenditures. The growth rate for capital investment should return to its equilibrium value if the growth rate for industrial fuels and materials were also adjusted upward. Consequently, it may be useful to use a difference of growth rates in the investment specification rather than the growth rate for operating and maintenance expenditures.

2. Military Procurement

As indicated in Chapter One, the estimates of military procurement by Cohn and Lee are very different--in absolute value, historical trend, and serial pattern. Consequently, it is not surprising that specifications developed for the two estimates should differ, and the derived model simulations should give different results. There are, however, certain features of the two systems which are similar. In both systems, an increase

in military procurement expenditures tends to raise capital investment in machine building and metalworking and in ferrous metallurgy. In both Cohn and Lee systems, a short-run increase in military procurement shifts the composition of investment away from construction toward equipment.

The principle differences in the Cohn and Lee procurement impacts occurs in the response of total capital investment. In the Cohn version, an increase in the growth rate of military procurement reduces capital investment in the short run and that reduction persists throughout the projection period. In fact, the response is greater than unity so that consumption actually rises above the baseline path because the GNP impact multiplier is smaller than the investment multiplier (see Table 3, Chapter II).

In contrast, an increase in military procurement sustained in the Lee system raises capital investment in the short run and depresses consumption. However, the increases in capital investment eventually generate higher levels of GNP which allow even consumption to rise above its baseline values. This process takes more than five years to result in an improvement in consumption from an increase in defense procurement (see Table 3, Chapter II).

Neither of these dynamic properties for procurement impacts corresponds to the conventional wisdom. While the long-run consequences of depressed GNP and consumption in the Cohn version are plausible, the short-run rise in consumption levels does appear to be questionable. In the Lee version, the short run reduction in consumption appears plausible but the long-run gain in consumption through augmented capital accumulation will depend upon the relationship between capital growth, GNP growth and realized defense procurement growth. These divergent patterns arise specifically from the different impacts of procurement on industrial investment given the two estimates. Resolution of this problem may ultimately depend upon some resolution of the procurement estimates. We are clearly unable to resolve that broader question on the basis of present econometric analysis.

3. The Planned Procurement Effect

This is perhaps the most interesting contribution of current research effort, but there are certain problems with casual interpretation and the magnitude of estimated dynamic multipliers. As presented, it begins with an assumption that future procurement of military durables is anticipated correctly and that current investment plans incorporate such anticipations. Given the technological relationship between past creation of capacity and current production of durables in the Soviet economy, the estimated coefficient may overstate the foresight of Soviet planners and consequently enlarge the derived dynamic multiplier. In this regard, it is important to note that in the investment equations using the Lee estimates of procurement, the planned procurement variable eliminated the planned investment variable which was used in the Cohn specification. If future procurement is correctly anticipated and the Lee estimates are reasonable representations of such expenditures, then the possibility arises that the published annual plan for capital construction does not incorporate full information possessed by planners.

In regard to the reasonableness of the dynamic multipliers based upon the Lee estimations and specification, it is most useful to look at the set of scenarios prepared at the end of Chapter II. When all categories of defense expenditures were reduced by 10 percent in stages through 1980, the Lee version indicated a reduction in the 1985 level of GNP of 1.8 Billion rubles. However, because of the reduction in defense expenditures by 1985, consumption was reduced by less than 0.4 Billion rubles. In the Cohn version, GNP in 1985 had risen by 1 Billion rubles; but because of the increase in capital investment, there was again a small reduction in 1985 consumption by 0.8 Billion rubles. These divergent results, once again, reflect the substantial divergence between the Cohn and Lee estimates of military procurement over the period 1958-1975.

C. Implications for the Evaluation of Alternative Estimates of Soviet Defense Expenditures

In the preparation of this research, it was not expected that econometric estimation would provide strong criteria for selecting among alternative estimates of Soviet defense expenditures. It was hoped, however, that experimentation with various estimates would exclude estimates which were inconsistent with observed data and that model simulation would exhibit the dynamic implications of alternative versions. We feel that, although many questions remain open, those modest aspirations have been attained.

None of the available estimates of military procurement has been rejected on the basis of econometric evidence. If the specification used for the Cohn (and OSR) estimates were accepted as the standard, the Lee estimates would be judged statistically insignificant. If the Lee specification, however, were used as the standard, the Cohn estimate would be rejected as statistically insignificant. Clearly, further work is required to promote some convergence in alternative estimates of military procurement--their levels, trends and serial patterns. The current effort of Stanley Cohn to utilize the Lee "residual" methodology with a correction for new product pricing may contribute to that convergence. Similarly, the publication of the revised OSR ruble estimate back through 1961 would also promote this scientific interchange.

At this stage of our understanding, we will offer some tentative judgments on the Cohn and Lee estimates:

- The multiplier for the Cohn estimate of operating and maintenance expenditures appears plausible in the short run (0.6) but too large under dynanamic simulation.

- The multiplier for the Cohn estimate of military procurement (state reserves increments) appears to be too low and the coefficients are not very significant at the sector and branch levels. The serial pattern of this estimate does not provide very much information for the macromodel.

- Though the level and trend of the Lee estimate for military procurement may be too high, the serial pattern does provide valuable information when appropriately smoothed through the planned procurement variable. The derived multipliers for procurement again appear more plausible in the short run than in long run simulations (where they appear to be too large).

D. Implications for the Model Specification of Defense Impacts on Capital Investment

The major problem with the specification of capital investment in SOVMOD III remains the absence of an explicit balancing system for durables--structures and machinery. Since the balance is implicit in observed data, the problem only becomes serious when major counterfactual scenarios or long-run projections are involved. It is only within such a specification that one can hope to make operational the distinction between short-run and long-run tradeoffs between defense expenditures and other categories of end use. Such a specification could emerge through a more extensive integration of the input-output system in the determination of end use categories.

A second area for further econometric research would be the establishment of a multistage determination of capital investment at the sector level. First, the structural and budgetary categories of capital investment would be determined by plans, defense expenditures, profits and the supply of durables. Second, the sector and branch categories of capital investment would be related to those structural and budgetary categories, with deviations caused by macroeconomic contingencies and administrative interventions. The deviation between the projection of

aggregate capital investment and the sum of sector investments could then be used to determine residual categories or to adjust previous solution values in an iterative process.

APPENDICES

"PLANS, DEFENSE EXPENDITURE AND PROFITS:

THE DETERMINANTS OF SOVIET CAPITAL INVESTMENT"

by

Donald W. Green

April, 1977

Soviet Econometric Model
WORKING PAPER #56

Outline

1. Previous Results and New Objectives for Research
2. The Data: Independent and Dependent Variables
3. New Results:
    (a) Structures vs. Machinery and Equipment
    (b) Centralized vs. Decentralized
    (c) Agriculture vs. Non-agriculture
4. Summary

Appendix A: Sectoral and Branch Investment Equations

I. PREVIOUS RESULTS AND NEW OBJECTIVES FOR RESEARCH

In an earlier study, a macroeconomic theory of Soviet capital investment was developed which emphasized quantity signals in a bureaucratic economy [1]. That research demonstrated the role of the Five-Year Plan, the Annual Plan for Capital Construction, and nonpersonnel defense expenditures in the determination of capital investment at the sector and branch levels. It also suggested the importance of gross profits as an indicator of bureaucratic concern with disequilibrium on the market for wage goods. This approach proved quite controversial and generated criticism on several grounds:

(1) the complexity of the specification for sector equations;

(2) the use of dummy variables;

(3) the measurement of defense expenditure; and

(4) the interpretation of the gross profit impact on capital investment.

The current study represents the author's attempt to explore the macroeconomic approach to Soviet capital investment from a somewhat different perspective. The new approach is to disaggregate capital investment expenditures by producing sector rather than by purchasing sector and to introduce a further dichotomy between centralized and decentralized investment. In the process, we have also refined the measurement of the Plan variable and utilized an improved measure of Soviet defense expenditure contributed by Stanley Cohn.

In the next section, we will describe the data used for dependent and independent variables in the regressions. Then, the regression results will be discussed for three major dichotomies: (a) structures vs. machinery

and equipment; (b) centralized vs. decentralized investment; and (c) agricultural vs. non-agricultural investment. The final section summarizes our present understanding of the determinants of capital investment in the U.S.S.R. A revised set of sectoral and branch investment equations are presented in an Appendix to this paper.

II. THE DATA: INDEPENDENT AND DEPENDENT VARIABLES

The investment data used in this study were all derived from Soviet official sources and are documented in the notes to Table 1. Each of the original series is available from 1956-1975 but in two overlapping series in different prices. Using the overlapping period from 1961-1965, the earlier data is converted to 1969 investment prices. The data for total investment, construction-installation work, and machinery and equipment provides a residual estimate for the category of design and other capital work. The other two original series used are for total state centralized capital investment and state centralized construction-installation work. The remaining series are derived from the five original series as defined in the notes to Table 1. Residual categories are determined for state centralized machinery and other investment, total decentralized investment, decentralized construction-installation work, and decentralized machinery and other investment.

The growth rates for these various categories of capital investment are displayed in a sequence of graphs below. Graph 1 indicates the shifts in the composition of capital investment between structures and machinery.

TABLE 1

CATEGORIES OF SOVIET NEW CAPITAL INVESTMENT

SYMBOL	DESCRIPTION	DERIVATION
IT	Total New Capital Investment	Nar.Khoz
ICO	Construction-Installation Work	Nar.Khoz
IME	Machinery and Equipment	Nar.Khoz
IO	Design and Other Capital Work	IO ≡ IT-ICO-IME
ICT	Centralized Capital Investment	Nar.Khoz
ICC	Centralized: Construction-Installation	Nar.Khoz
ICM	Centralized: Machinery and Other	ICM ≡ ICT-ICC
IDT	Decentralized Capital Investment	IDT ≡ IT-ICT
IDC	Decentralized: Construction-Installation	IDC ≡ ICO-ICC
IDM	Decentralized: Machinery and Other	IDM ≡ IDT-IDC
IA	Agricultural Capital Investment	Nar.Khoz
IAC	Agricultural: Structures	Nar.Khoz
IAM	Agricultural: Machinery and Other Industrial Objects	Nar.Khoz

Sources:

IT, ICO, IME: Nar.Khoz.75, p. 503; Nar.Khoz.70, p. 479; Nar.Khoz.68, p. 520; Nar.Khoz.65, p. 529

ICT, ICC: Nar. Khoz.75, p. 505; Nar.Khoz.68, p. 521; Nar.Khoz.65, p. 530

IA, IAC, IAM: Nar.Khoz.75, p. 512-513; Nar.Khoz.70, p. 487; Nar.Khoz.68, p. 526; Nar.Khoz.65, p. 537

TABLE 1

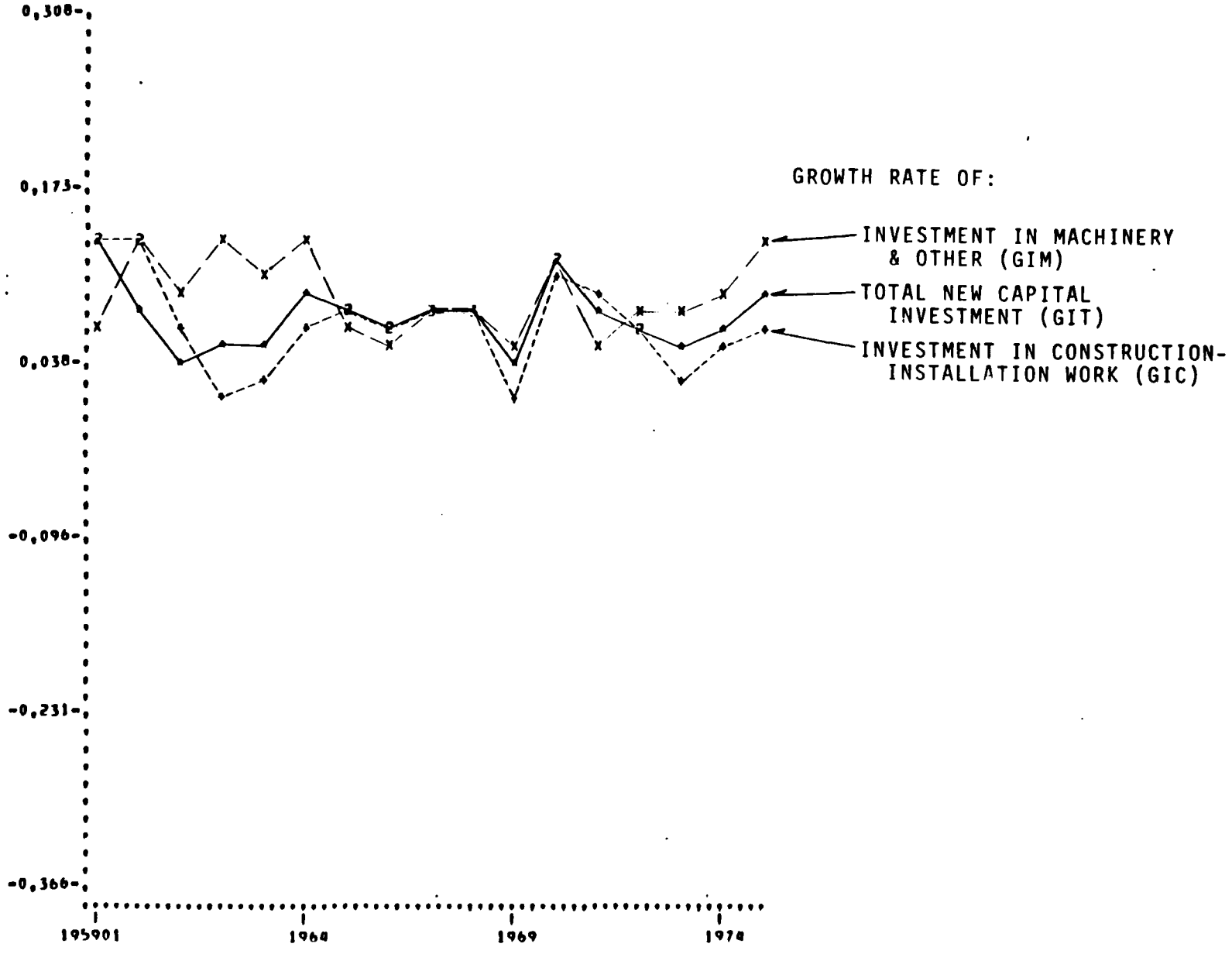
CATEGORIES OF SOVIET NEW CAPITAL INVESTMENT

	IT	ICO	IME	IO	ICT	ICC	ICM	IDT	IDC	IDM	IA	IAC	IAM	INA
1958	34.240	21.8	8.8	3.64	24.13	15.65	8.48	10.11	6.15	3.96	4.940	N.A.	N.A.	29.300
1959	38.757	24.7	9.4	4.66	26.82	17.65	9.17	11.94	7.05	4.89	5.280	3.318	1.962	33.477
1960	41.985	27.9	10.6	3.48	30.22	19.90	10.32	11.76	8.00	3.76	5.476	3.781	1.695	36.585
1961	43.800	29.8	11.6	2.40	32.91	21.28	11.63	10.89	8.52	2.37	6.000	4.110	1.890	37.827
1962	45.955	30.2	13.1	2.65	35.61	22.66	12.95	10.34	7.54	2.80	6.580	4.478	2.102	39.375
1963	48.308	31.0	14.5	2.81	37.95	23.78	14.17	10.36	7.22	3.14	7.259	4.863	2.396	41.048
1964	52.532	33.0	16.4	3.13	40.88	24.66	16.22	11.65	8.34	3.31	8.644	5.778	2.866	43.862
1965	56.915	35.8	17.5	3.62	43.4	26.0	17.4	13.51	9.8	3.71	9.535	6.374	3.161	47.380
1966	60.948	38.3	18.5	4.15	45.6	27.1	18.5	15.35	11.2	4.15	10.154	6.924	3.230	50.794
1967	66.026	41.5	19.9	4.63	48.0	28.9	19.1	18.03	12.6	5.43	10.840	7.431	3.409	55.186
1968	71.224	44.6	21.5	5.12	50 4	30.4	20.0	20.82	14.2	6.62	12.097	8.376	3.721	59.104
1969	73.594	45.3	22.5	5.79	52.3	31.3	21.0	21.29	14.0	7.29	12.605	8.631	3.974	60.960
1970	82.053	50.3	25.3	6.45	57.2	33.7	23.5	24.85	16.6	8.25	14.380	9.912	4.468	67.852
1971	87.982	54.7	26.6	6.68	61.1	36.5	24.6	26.88	18.2	8.68	16.526	11.778	4.748	71.565
1972	94.261	58.2	28.8	7.26	65.4	39.0	26.4	28.86	19.2	9.66	18.095	12.919	5.176	76.166
1973	98.684	59.6	31.1	7.98	70.2	41.2	29.0	28.48	18.4	10.08	19.985	14.022	5.963	78.699
1974	105.713	62.9	34.1	8.71	76.5	44.3	32.2	29.21	18.6	10.61	21.730	15.276	6.454	83.983
1975	115.095	66.8	38.5	9.80	83.9	47.4	36.5	31.19	19.4	11.79	23.659	16.559	7.100	91.436

A concentration on machinery and equipment is seen in the period 1962-1964 and again in 1973-1975. Graph 2 displays the shift between centralized and decentralized investment over the sample period. Decentralized investment was sharply constrained in the period 1961-1964 (decentralized housing investment was particularly depressed in those years), expanded significantly in 1965-1969 with another period of restraint appearing after 1972. The composition of centralized investment is displayed in Graph 3 and follows closely the pattern of Graph 1. The composition of decentralized investment appears in Graph 4 which indicates the volatility of the category for decentralized machinery investment (GIDM). It peaks in the period 1967-1968 before the restrictions imposed in 1969, a pattern which appears in other indicators influenced by the 1965 industrial reform.

Recent work on the measurement of the determinants of capital investment has been incorporated in this research. Previously, the ruble budget for centralized capital investment in current rubles was used in the definition of the plan variable. A growth rate for budget finance was computed using an investment deflator for Soviet industry. The collection of further information on the Annual Plan for Capital Construction provided a growth rate series for centralized investment which is superior both conceptually and empirically[2/]. This new variable is GPIN9, the planned rate of growth for centralized new capital investment.

In a 1976 working paper, Cohn revised his budgetary division of the official Soviet defense budget and added a supplementary estimate for additions to state reserves[3/]. Consequently, there are now two measures of defense expenditure in our analysis of capital investment. The first measure is GDF, the growth rate of nonpersonnel defense expenditures, a category for operating, maintenance and construction expenditures. The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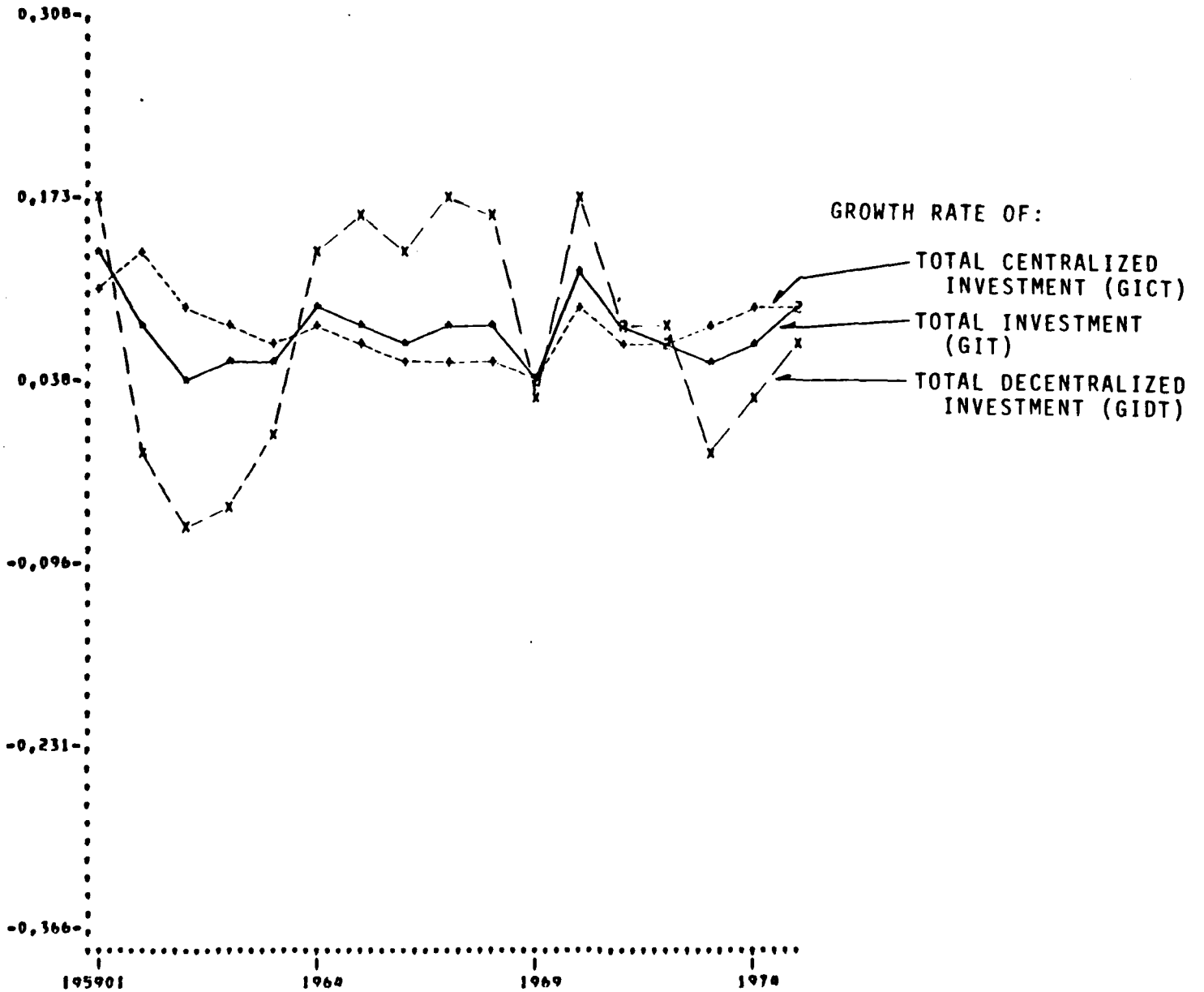
GROWTH RATE OF:
INVESTMENT IN MACHINERY & OTHER (GIM)
TOTAL NEW CAPITAL INVESTMENT (GIT)
INVESTMENT IN CONSTRUCTION-INSTALLATION WORK (GIC)

GRAPH 1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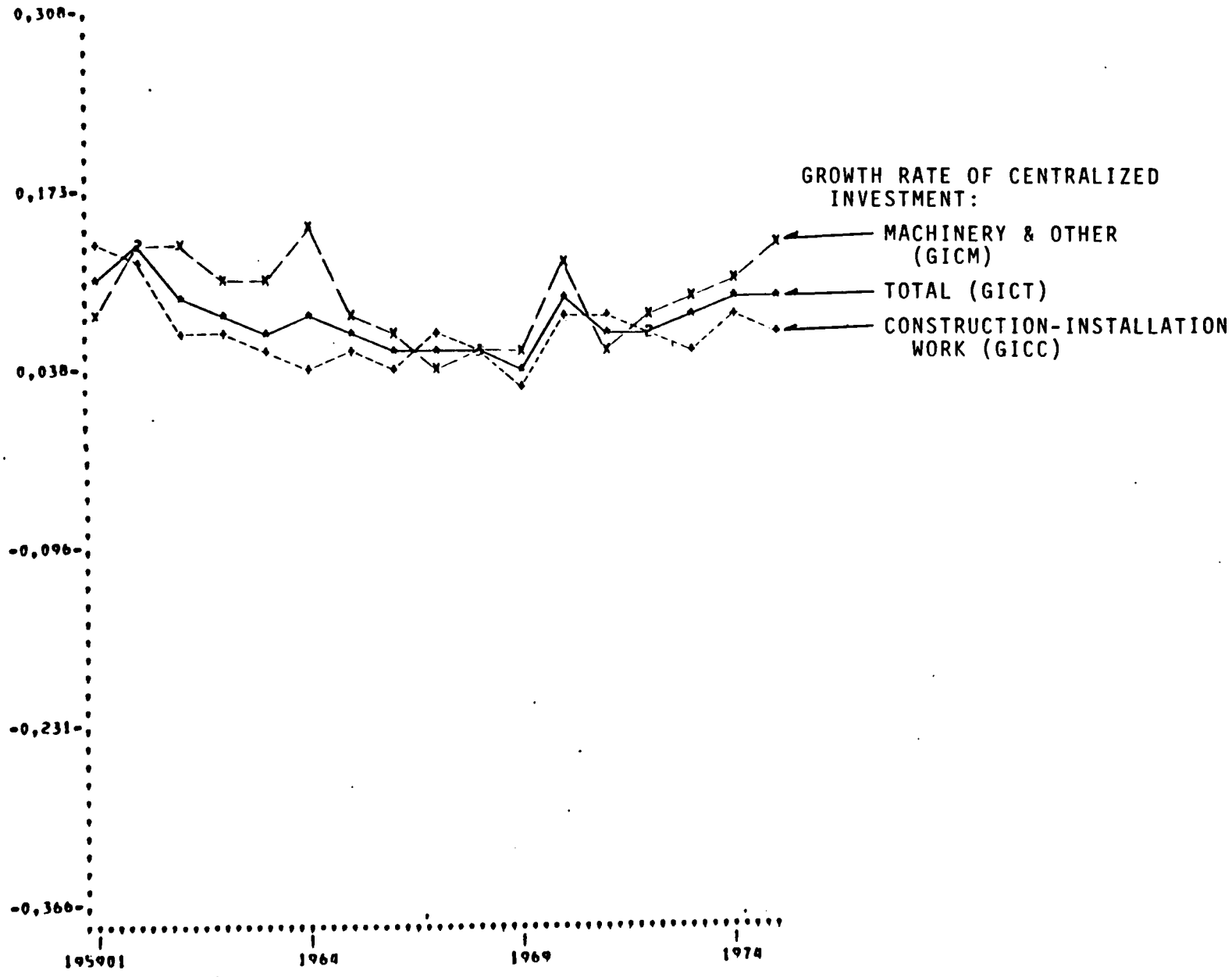
GROWTH RATE OF:
TOTAL CENTRALIZED INVESTMENT (GICT)
TOTAL INVESTMENT (GIT)
TOTAL DECENTRALIZED INVESTMENT (GIDT)

GRAPH 2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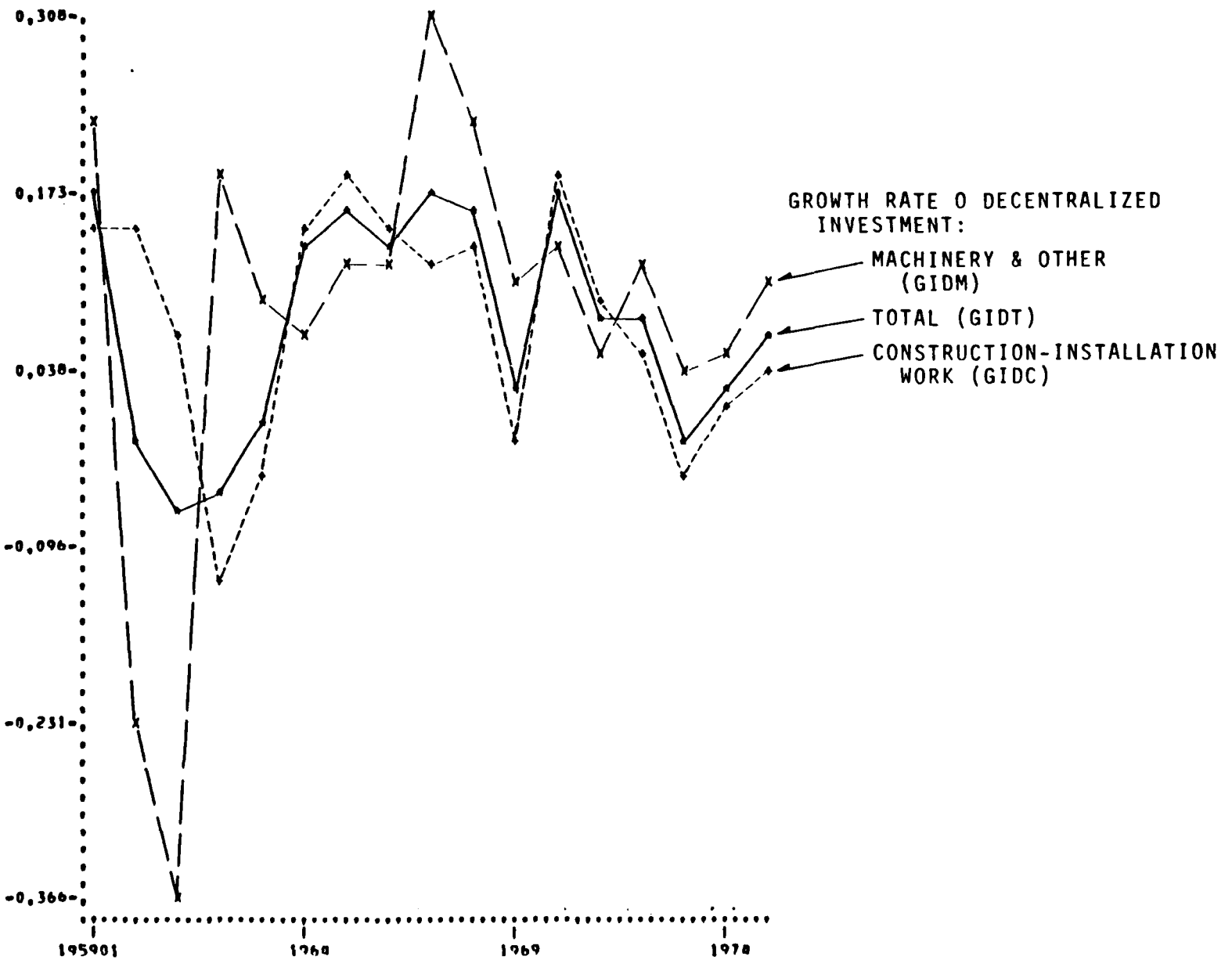
GROWTH RATE OF CENTRALIZED INVESTMENT:
MACHINERY & OTHER (GICM)
TOTAL (GICT)
CONSTRUCTION-INSTALLATION WORK (GICC)

GRAPH 3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GROWTH RATE O DECENTRALIZED INVESTMENT:
MACHINERY & OTHER (GIDM)
TOTAL (GIDT)
CONSTRUCTION-INSTALLATION WORK (GIDC)

GRAPH 4

current ruble series BDN*9 is deflated by the official wholesale price for heavy industry (PIWH70):

$$GDF = \frac{BDN*9/PIWH70}{BDN*9_{-1}/PIWH70_{-1}} - 1.$$

In some cases there appears to be a gain in the serial properties of investment equations when this growth rate is smoothed with its value in the previous year:

$$GDFS = \left(\frac{BDN*9/PIWH70 + BDN*9_{-1}/PIWH70_{-1}}{BDN*9_{-1}/PIWH70_{-1} + BDN*9_{-2}/PIWH70_{-2}}\right) - 1.$$

Cohn's estimation of State Reserves begins with a control total for annual growth in working capital and reserves. The estimate of the growth in state reserves is a residual after the subtraction of changes in working capital of State enterprises, unfinished construction and working capital of collective farms. This estimate of the change in State Reserves is now used as an indicator of Strategic expenditures beyond the official budgets for defense and science. The composition of this category remains unclear but it probably includes the procurement of military durables; its level is slightly below the O.S.R. published estimates of Soviet Military procurement[4/]. Since Cohn's preferred deflator for this series, an equal-weighted index of the official price index for MBMW and Becker's adjusted index, is virtually equivalent to a constant deflator the series has not been deflated. We have introduced this variable into our previous specification as a ratio to an index of machine-building and metal-working output, averaged with the

previous year:

$$BDM = \frac{BDSR*9}{XOMB} + \frac{BDSR*9_{-1}}{XOMB_{-1}}$$

A change in the "procurement share" is expected to influence the growth of capital investment this year and next year.

The profits variable remains the same as in the earlier study[5/]:

$$GPG = \frac{ZPG*/PII_{-1}}{ZPG*_{-1}/PII_{-2}} - 1.$$

Gross profits are deflated by the industrial investment deflator and therefore represents a measure of real industrial investment at prevailing prices. The dummy variable for the five-year plan period is also unchanged and is described elsewhere[6/].

Finally, there is a dummy variable QFIN which is introduced to measure the impact of centralized campaigns to complete unfinished investment projects and to prohibit the initiation of new projects. In the period 1966-68 there was a rapid increase in the volume of unfinished construction because of a relocation in central budgetary control over collective farms, municipal governments and industrial enterprises. This expansion is shown in Figure 5 below. In 1969, centralized con-rol over construction activity was strengthened in order to accelerate the completion of projects by the end of the Eigth Five-Year Plan (1966-70). In the 1973 Annual Plan for Capital Construction, a similar intervention was called for in order to prevent a reoccurance of the 1968-1969 situation. In the estimations reported here, this variable QFIN has replaced the Q69 used in the earlier study.

III. NEW RESULTS

(A) Structures vs Machinery Equipment (Table 2)

We began our investigation with an estimation for total new capital investment based upon earlier results at the sector and branch levels. The equation

TABLE 2

DETERMINANTS OF THE COMPOSITION OF CAPITAL INVESTMENT: STRUCTURES AND MACHINERY*

GROWTH RATE CATEGORIES	SYMBOL (MEAN)	CONSTANT	PLAN GPIN9	DEFENSE O & M GDF, GDFS	DEFENSE DURABLES BDM	GROSS PROFITS GPG	FIVE-YEAR PLAN QFYP	R^2	D.W.
TOTAL NEW CAPITAL INVESTMENT	GIT (0.074)	0.073 (2.79)	0.404 (2.30)	GDF -0.086 (2.90)	-0.152 (1.72)	0.101 (2.12)		0.634	2.32
TOTAL CONSTRUCTION-INSTALLATION WORK	GIC (0.069)	0.054 (1.52)	0.756 (3.17)	GDFS -0.082 (3.01)	-0.167 (1.40)	0.097 (1.36)	-0.011 (0.84)	0.685	1.14
TOTAL MACHINERY & EQUIPMENT	GIM (0.093)	0.130 (5.00)	0.581 (3.48)		-0.446 (4.43)	0.161 (3.20)	0.026 (2.91)	0.764	2.43
TOTAL DESIGN AND OTHER CAPITAL WORK	GIO (0.106)	0.089 (9.61)		GDF -0.094 (1.30)		0.205 (3.05)		0.480	1.95
NON-AGRICULTURAL INVESTMENT	GIN (0.070)	0.067 (2.36)	0.504 (2.64)	GDF -0.098 (3.05)	-0.193 (2.01)	0.142 (2.74)		0.694	1.94

*Sample period: 1959-75 for GIT, GIC and GIN; 1960-75 for GIM; and 1962-75 for GIO. Coefficient t-statistics are given in parentheses below their value.

presented in Table 2 includes the constant term and four significant variables: the plan for centralized investment, nonpersonnel official defense expenditures, the state reserves ratio to machine-building, and gross profits. All coefficients have the expected sign and are significant at the 5% level.

The disaggregation of total investment into three functional categories as presented in Table 2 does add to our understanding of the investment process. With functional disaggregation, we have added the five-year plan variable which is more significant in the composition between structures and machinery; toward the end of a five-year plan, the composition shifts from structures to machinery. The first defense variable GDF is not significant in the determination of machinery and equipment but continues to have an impact other capital work. The last estimation has been shortened because of the inflated values for that category in 1958-1960.

(B) Centralized vs. Decentralized (Table 3)

This disaggregation clarifies further our econometric understanding of this behavioral process. In the centralized sphere, which includes all large projects specified in the five-year plans and annual plans, we find significant coefficients for the plan, the state reserves, and the five-year plan. Interestingly, the equation for total centralized investment gives superior results to the disaggregation into centralized structures and others. The composition effect of the five-year plan appears again in the disaggregated equations.

In the decentralized sphere, the plan and state reserves variables are insignificant. Decentralized investment appears to depend upon nonpersonnel defense expenditures, gross profits and the finishing campaigns. These campaigns appear to have sharply restricted construction with decentralized financing by 10% in 1969 and 1973. Again, the equation for total

TABLE 3

BUDGETARY COMPOSITION: CENTRALIZED AND DECENTRALIZED*

GROWTH RATE CATEGORIES	SYMBOL (MEAN)	CONSTANT	PLAN GPIN9	DEFENSE O & M GDF, GDFS	DEFENSE DURABLES BDM	GROSS PROFITS GPG	FIVE-YEAR PLAN QFYP	FINISHING CAMPAIGN QFIN	R^2	D.W.
TOTAL CENTRALIZED INVESTMENT	GICT (0.076)	0.117 (5.98)	0.403 (3.09)		-0.301 (4.59)				0.693	2.18
CENTRALIZED CONSTRUCTION - INSTALLATION WORK	GICC (0.068)	0.129 (5.15)	0.335 (2.02)		-0.347 (4.14)		-0.010 (1.11)		0.649	1.64
CENTRALIZED MACHINERY AND OTHER	GICM (0.090)	0.085 (1.99)	0.556 (1.95)		-0.211 (1.47)		0.024 (1.66)		0.389	2.13
TOTAL DECENTRALIZED INVESTMENT	GIDT (0.072)	0.052 (2.49)		GDFS -0.207 (3.43)		0.447 (2.90)		-0.056 (1.29)	0.622	1.58
DECENTRALIZED CONSTRUCTION - INSTALLATION WORK	GIDC (0.074)	0.063 (2.77)		GDFS -0.207 (3.18)		0.352 (2.12)		-0.010 (2.10)	0.599	1.38
DECENTRALIZED MACHINERY AND OTHER	GIDM (0.080)	0.047 (0.98)		GDF -0.517 (2.51)		0.616 (1.74)			0.403	1.82

*Sample period is 1959-75 for all regressions.

decentralized investment is superior to the equations for its functional components. The largest coefficient for gross profits appears in the equation for decentralized investment in machinery and equipment.

(C) Agricultural and Nonagricultural (Table 4)

Another partition of considerable importance in the Soviet econmy is that between agriculture and other sectors. Within agricultural investment one may also distinguish a category of manufactured durables from construction-installation work. This category is slightly different from the structures-machinery dichotomy for total investment so we have not disaggregated non-agricultural investment further. If one compares the non-agricultural equation with that for total capital investment (both given in Table 2) all coefficients become more significant and larger.

Within agriculture, previous research had indicated the role of budget financing and the current and past harvests[7]. The relevant equations and definitions of variables are given in Table 4. Construction-installation work in agriculture is shown to be significantly related to the budget, the current harvest, and non-personnel defense expenditures. Agricultural machinery investment is significantly related to the budget, last year's harvest and defense druables. When defense procurement rises, there is a composition shift in agricultural investment from machinery to structures.

TABLE 4

AGRICULTURAL CAPITAL INVESTMENT*

GROWTH RATE CATEGORY	SAMPLE (MEAN)	CONSTANT	BUDGET GFA	DEFENSE O & M GDF, GDFS	DEFENSE DURABLES BDM	CURRENT HARVEST RXA	PAST HARVEST RXA_{-1}	R^2	D.W.
TOTAL AGRICULTURAL INVESTMENT	GIA (0.103)	0.050 (4.36)	0.450 (5.06)	GDF -0.136 (3.90)		0.279 (3.44)	-0.179 (2.29)	0.818	2.44
CONSTRUCTION INVESTMENT IN AGRICULTURE	GIAC (0.104)	-0.036 (0.64)	0.632 (4.67)	-0.198 (3.61)	0.276 (1.48)	0.414 (3.41)		0.712	2.33
MACHINERY INVESTMENT IN AGRICULTURE	GIAM (0.101)	0.212 (6.32)	0.096 (1.45)		-0.512 (4.43)		-0.474 (6.19)	0.875	2.10

*Sample period is 1961-1975.

Variables: GFA is the growth rateof state financing in the Annual Budget ex ante, adjusted for 1969 changes in durables prices.
RXA is the percentage deviation of actual agricultural output from normal output.

IV. THE DETERMINANTS OF NEW CAPITAL INVESTMENT: A SUMMARY

With the new partitions of capital investment expenditures, we may now summarize the role of major determinants: plans, defense expenditures, and profits. In the estimations reported in this paper, we have seen the significance of the planned growth rate for centralized investment in determining the realized growth rate for that category and for total capital investment. This variable is shown to be significant in both categories of structures and machinery. Furthermore, we have found that the financing of agriculture, as reported in the Annual Budget, is a major determinant of capital investment in agriculture, more significant for construction-installation work than for agricultural machinery. Clearly, the Soviet Annual Plan provides important ex ante information, though alone it would provide a very weak basis for prediction.

Information from the Plan must be supplemented by a consideration of defense expenditures, both the current operating expenditures of the Soviet defense sector and the expenditures on military procurement. The impact of defense operating expenditures appears most significantly in the structural categories, restraining total construction-installation activity, decentralized construction and agricultural construction.

The estimate of military procurement when related to total machine-building output has been shown to have a negative impact on centralized investment and on machinery investmnet more generally. This represents a short-run substitution of machinery output from civilian to military use. As noted in Appendix A, this procurement effect is much weaker at the sector and branch levels than at the aggregate level. This might indicate that the estimate of state reserves in a weak short-run indicator of military durables (because

of budgetary fluctuations) or that the substitution impact has shifted across sectors during the sample period.

The role of profits as a determinant of capital investment was tracked at some length in an earlier study. The present research has shown that the impact of gross profits appears signifi-antly only in the determination of decentralized capital investment. Here one is still uanble to separate planner's intentions from bureaucratic response to shorten contingencies. Central planners may shift financial parameters to generate profits to finance decentrlaiced investment. Short-run movements in gross profits that are not intended may also represent real scarcities which motivate bureaucratic restraint on decentralized capital investment.

The disaggregation of agricultural investment has also clarified the role of the state of the harvest. Current harvest conditions have a direct impact on construction activity in agriculture whereas deliveries of agricultural machinery are inversely related to the previous year's harvest. We have also observed an interesting impact of military procurement on the composition of agricultural investment, away from machinery toward structures.

Finally, we may note the importance of the five-year plan cycle and campaigns to finish priority construction projects. The primary impact of the Five-Year Plan appears in the composition of centralized investment, a shift toward machinery at the end of a Five-Year Plan. Part of the information previously summarized in the five-year plan variable is now provided in the planned annual growth rate for centralized investment. Finishing campaigns which appeared in 1969 and 1973 tended to restrain construction activity under decentralized direction, reducing the growth rate in that category by 1% in each year.

Footnotes:

1. Green and Higgins (1977), Chapter 5.
2. The determination of this series and its relationship to the budget data will be described in a forthcoming paper by the author.
3. Cohn (1976). These estimates have been revised for 1974 and extended to 1975 by the present author.
4. O.S.R. (1976).
5. Green and Higgins (1977), Chapter 5.
6. Green (#52) - Cap. Formation
7. Green and Higgins (1977), Chapter 5; and Green (1977).

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AN ALTERNATIVE SPECIFICATION OF THE ECONOMIC IMPACTS OF SOVIET DEFENSE PROCUREMENT

by

Daniel L. Bond

April 1977

Soviet Econometric Model
Working Paper # 57

Outline:

1. Background and Introduction
2. Specification of General Economic Impacts of Defense Procurement
3. Results of Procurement Impact Estimations
4. A More Detailed Examination of Impacts on Investment
5. Summary

1. Background and Introduction

In earlier studies by Dr. Donald Green, various economic impacts of Soviet defense expenditures were suggested, empirically tested, and later incorporated into the SRI-WEFA Soviet Econometric Model (SOVMOD).[1] In this work values for the two major components of non-personnel defense expenditures--defense procurement and operations/maintenance/construction expenditures--were obtained applying the estimate methods and results of Dr. Stanley Cohn.[2] Professor Cohn's method, which is based on evaluation of published Soviet budget data, is subject to wide and unknown margins of error, as Cohn has made clear in his presentations on this topic. Since the Soviets have made public no direct information on non-personnel defense expenditures, such uncertainty in their estimation by Western analysts is unavoidable. This being the case, it is useful to examine, along the lines laid out by Green, other estimates of Soviet defense expenditures to see what different results would be obtained--both in the understanding of the role of defense in the Soviet economy and in the implication for econometric modelling of using different estimates of Soviet defense expenditures.

In addition to Cohn's work there are two major alternative estimation approachs being used in the U.S.--the Office of Strategic Research (C.I.A.) costing method, and the machinery production residual approach of Mr. William Lee.[3] In this paper we will present the results of a study of defense impacts in which some of Mr. Lee's estimates are used.

In the next section of the paper is suggested a sequence of impacts on investment, production, trade, and consumption which could be expected from a change in the level of defense procurement. Equations were specified based on this impact sequence, and the results of single equation estimations are presented and discussed in the third part of the paper. This is followed by a more detailed examination of impacts on components of investment distinguished by type of control (centralized vs. decentralized) and type (machinery and equipment vs. construction and installation).

2. Specification of General Economic Impacts of Defense Procurement

The key component of Soviet defense expenditures, and the one for which the various Western estimations have produced the most divergent results, is procurement of military durables. In studying the relation of defense to the domestic economy military procurement is important primarily due to its relation to investment. It is reasonable to expect that the production of military arms and equipment requires resources and production capacity that could otherwise be used for creating producer durables, and thus lowers the level of non-military capital investment.

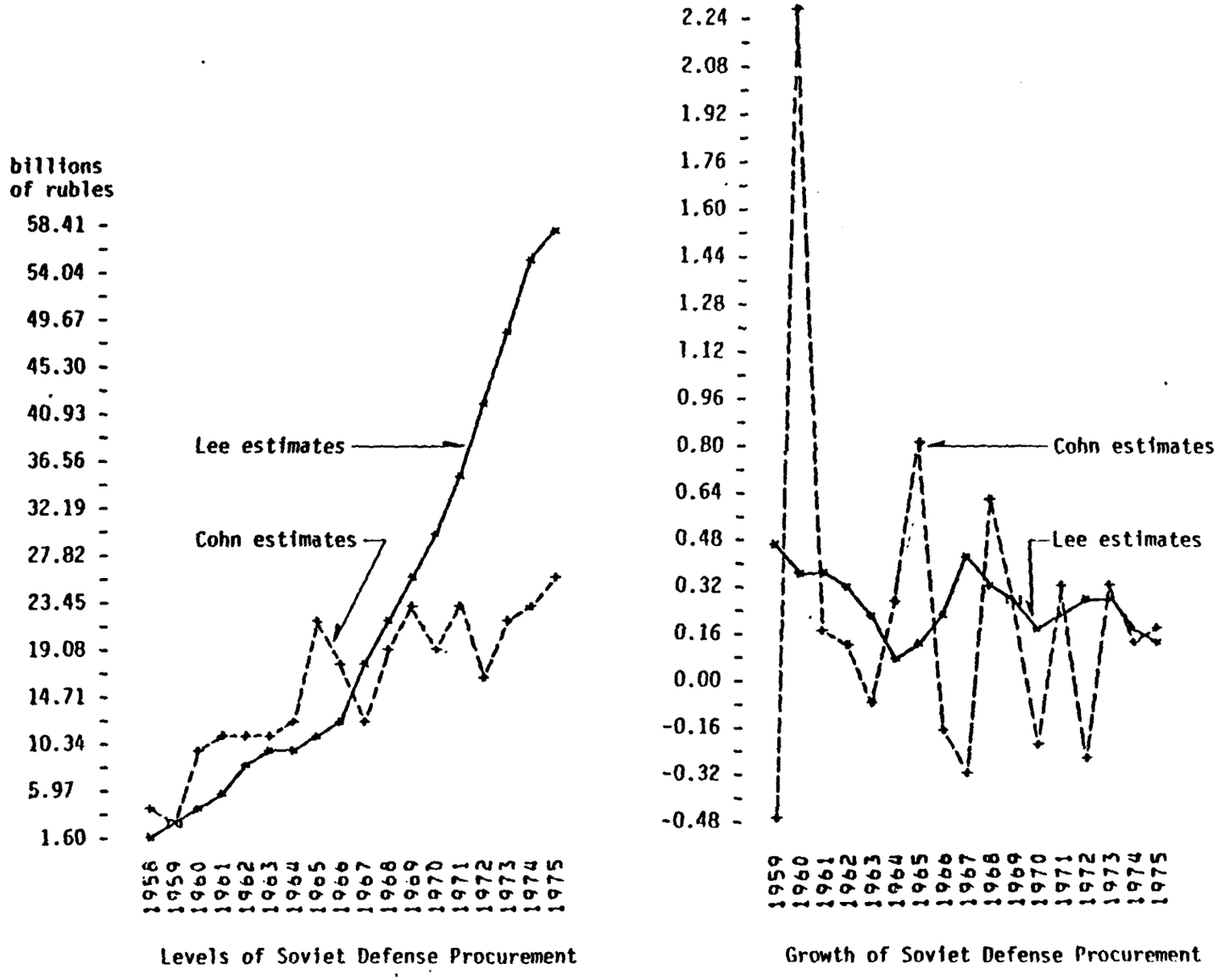
Using Cohn's estimates of "state reserves" (which is thought to include the procurement of military durables), Green was able to document such impacts on total investment and various disaggregations of investment by branch and type. In addition, he found a significant difference in the impact of procurement by form of administrative control--the impact was significant for investment which was centrally controlled, but not for decentralized investment.[4]

There is controversy in the estimation of the volume and growth of Soviet military procurement because this is among the most carefully concealed of their information, and decause indirect estimation is beset by many and complex difficulties. As a supplement to the earlier work on military impacts reported by Green, in this paper will be presented the

results of a similar study, but one in which the Lee estimates of military procurement expenditures will be used in place of those used by Green. For a second important component of the defense budget, covering operating, maintenance and construction expenditures, we will, as in Green's study rely on Cohn's estimate of these "non-personnel" costs. (Most major military construction is not covered in this category, but is combined with purely civilian or joint-purpose construction.) Although Lee has also prepared such a series, there are no significant differences with Cohn's, and so it was not used.The impact on labor supply, and in other areas of the economy, of military manpower has not been examined in this or the Green studies.

The Lee estimates of Soviet military procurement are substantially different from Cohn's, both in levels and rates of growth. In Figure 1 both series are presented for comparison in these ways.[5] Given such differences, it would not be expected that the substitution of the Lee data for those of Cohn would, in the same specifications, give similar results. Indeed, when tested, this was the case--the sign of the Lee variables being wrong, or the coefficients being insignificant statistically.

Faced with these results, but wanting to test Lee's procurement estimates as an alternative in full model simulations using SOVMOD, it was decided that other specifications of defense impacts should be examined.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of rubles
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Lee estimates
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Levels of Soviet Defense Procurement
2.24
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1.44
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Cohn estimates
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Growth of Soviet Defense Procurement

Figure 1.

One formulation of the defense procurement variable which had not been considered in earlier studies, but which on a priori grounds should be significant for investments functions, is planned growth of output of military durables. In Green's studies current procurement expenditures were associated with a reduction in current levels of investment. This is reasonable since given a relatively fixed level of durables production capacity in a given year the greater the level of defense durables output, the lower must be the output of non-defense durables, and thus investment. (The role of other sources and uses of durables, i.e., machinery imports and exports, and consumer durables, will be considered below.) However, in a planned economy we should also expect that such trade-offs should and could be avoided under normal circumstances. This could be achieved by correct planning of capacity expansion in those sectors producing durables. If an arms build-up is planned for some future period, then appropriate additional investment in the machine-building branches should occur with sufficient lead time to insure that all future needs for durables can be met. Of course, given resource constraints and short-falls in plan fulfillment, it is possible that capacity may still be inadequate in any given year, so that there will still be competition between the various uses for the available output of durables. And in a crisis situation, procurement of arms may have to be increased rapidly, also putting pressure on capacity and displacing competing uses.

The above considerations lead to the testing of various investment functions in which two defense procurement variables were present. One was a "planned procurement"variable, expressed as the growth of military procurement over several future years relative to past and current levels, and the second was a "procurement shift" variable, expressed as the difference between the current and previous year's rate of growth of procurement.

The "planned procurement" variable was designed to represent the impact of planned changes in defense procurement on investment for capacity expansion of those branches involved in military hardware production. It was thus expected that there should be a significant positive relation between the growth of this variable and the growth of investment in the machine building and metal-working (MB&MW) branches. In addition, a similar effect should appear for branches supplying significant intermediate inputs to the MB&MW branches. A second type of impact also seems reasonable. Since investment goods at any time are in limited supply, an increase in the share of investment going to one or more branches of the economy will reduce the share going to some other branches. Thus the appearance of a negative impact from the "planned procurement" variable would not be surprising in investment functions for non-defense related branches.

The correct form of the "planned procurement" variable is problematic. First, since we do not have available the actual planned levels of defense procurement, we must resort to using the estimated realized levels.

Second is the question of the number of lead years to include, and the weights to assign to the levels of procurement in these years. Not knowing the lags involved in the capital formation process for the defense industries, we went through a search process in which various periods of from one to three years, with various weights, were tried with an equation linking MB&MW investment and the Lee procurement estimates. The best fit was found using growth of the sum of procurement for three (equally weighted) lead years over the same for the three previous years:

$$D.BDPR09+3 \equiv \frac{BDPR09_{+1} + BDPR09_{+2} + BDPR09_{+3}}{BDPR09_{-2} + BDPR09_{-1} + BDPR09} - 1.0$$

(where BDPR09 is a series based on the Lee estimates of defense procurement expenditures)

The "procurement shift" variable was expressed as:

$$Y.D.BDPR09 \equiv \frac{BDPR09}{BDPR09_{-1}} - \frac{BDPR09_{-1}}{BDPR09_{-2}}$$

An increase in this variable's value, which is a measure of the degree of change in rate of growth of defense procurement, is expected to show a negative impact on the level of durables going into investment. The cause of this could either be: (1) a sudden increase in defense procurement resulting from some crisis response for which capacity increases could not be planned and prepared for in advance; or,

Second is the question of the number of lead years to include, and the weights to assign to the levels of procurement in these years. Not knowing the lags involved in the capital formation process for the defense industries, we went through a search process in which various periods of from one to three years, with various weights, were tried with an equation linking MB&MW investment and the Lee procurement estimates. The best fit was found using growth of the sum of procurement for three (equally weighted) lead years over the same for the three previous years:

$$D.BDPRO9+3 \equiv \frac{BDPRO9_{+1} + BDPRO9_{+2} + BDPRO9_{+3}}{BDPRO9_{-2} + BDPRO9_{-1} + BDPRO9} - 1.0$$

(where BDPRO9 is a series based on the Lee estimates of defense procurement expenditures)

The "procurement shift" variable was expressed as:

$$Y.D.BDPRO9 \equiv \frac{BDPRO9}{BDPRO9_{-1}} - \frac{BDPRO9_{-1}}{BDPRO9_{-2}}$$

An increase in this variable's value, which is a measure of the degree of change in rate of growth of defense procurement, is expected to show a negative impact on the level of durables going into investment. The cause of this could either be: (1) a sudden increase in defense procurement resulting from some crisis response for which capacity increases could not be planned and prepared for in advance; or,

(2) an increase in procurement which combined with producer and consumer durables demand exceeds the output capacity of the durables producing industries. This latter situation could occur in non-crisis situations if plans for capacity expansion are not fulfilled on schedule.

The movement of these two variables, as well as the third defense variable used in the tests (D.BDN*9/PIWH70--the rate of growth of the deflated Cohn series for non-personnel expenditures), for the period 1958 to 1972 is plotted in Figure 2.

In tracing through the impacts of military procurement, one should also consider certain ties with trade and consumer demand. If military procurement demands are high relative to the output of the durables producing sectors there are a number of courses of action from which economic planners may choose. As discussed above, planned investment in machinery and equipment may be cut back. But there are also possibilities for maintaining planned investment: reduction of output of consumer durables or increased imports (and/or decreased exports) of machinery. To test for these impacts we used a "durables demand" variable in a number of trade equations and the consumer durables consumption equation. This variable is:

$$Y.BD+IM.XOMB \equiv \frac{IM + BDPR09}{XOMB}$$

(where IM is total investment in machinery and equipment and XOMB is the O.E.R. index of MBMW gross output)

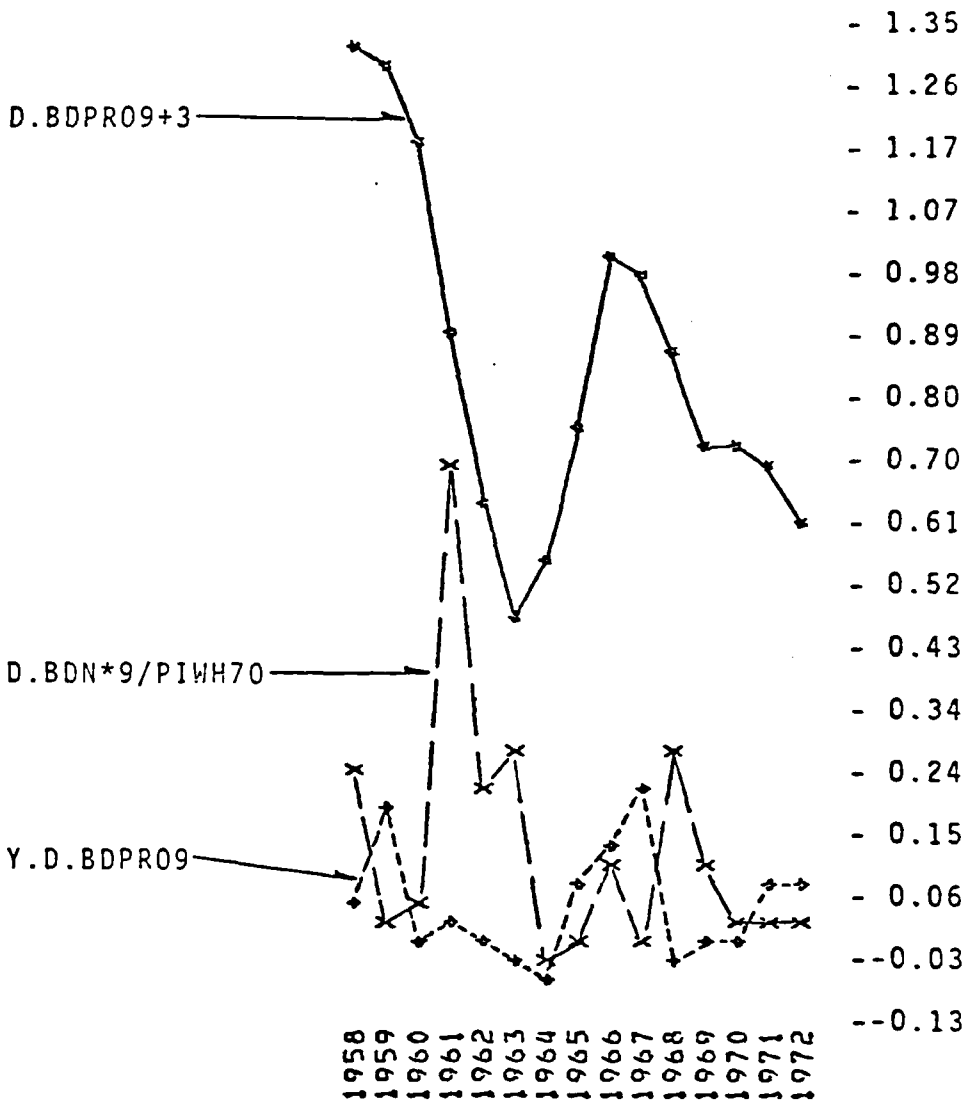
D.BDPR09+3
D.BDN*9/PIWH70
Y.D.BDPR09
- 1.35
- 1.26
- 1.17
- 1.07
- 0.98
- 0.89
- 0.80
- 0.70
- 0.61
- 0.52
- 0.43
- 0.34
- 0.24
- 0.15
- 0.06
--0.03
--0.13
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972

Figure 2.

A final factor which we wished to consider was the qualitative impact that the high priority and concentration of scientific and management talent on military production may have played on the productivity of various sectors of the Soviet economy. Professor Cohn has presented some evidence that during period of heavy defense spending productivity changes (as measured by marginal capital-output ratios) were more favorable for the MB&MW branches than for branches producing primarily civilian goods.[6] To test for such effects we estimated rate of growth production functions including both time trend and defense procurement variables, with the expectation that some portion of disembodied technological growth unexplained by the time trend would be associated with levels of defense procurement. A positive impact would be expected for the MB&MW branches, and a negative or nominal impact for most other branches.

3. Results of Procurement Impact Estimations

As a result of single equation estimations based on the defense impacts described above, we were able, using the Lee estimates of defense procurement, to obtain a sequence of equations which bore out our expectations of the direction of these impacts. The most interesting of these relations are represented schematically in Figure 3, with the equations and selected statistics given in Table 1. We may describe the sequence in the following way:

When plans for future military procurements are made they are coordinated with planned capacity increases for the MB&MW branches (1)* and its suppliers in the ferrous metals branch (2). If these increases put pressure on the investment capacity of the economy, it may be agricultural investment which suffers most, as indicated by the negative impact found for the two agricultural investment equations (3 & 4). Overall industrial investment (5) shows a slight positive relation to the movement of the "planned procurement" variable, indicating that there is a mild drop in non-defense industry. However, this drop was not sufficiently great to show up in individual branch equations. Abrupt increases in defense expenditures, as represented by the "procurement shift" variable, cause a drop in total economy-wide machinery and equipment investment (6). While defense drives output of MB&MW through

*The numbers in parentheses refer to the relations so indicated in Figure 3, and the equations presented in Table 1.

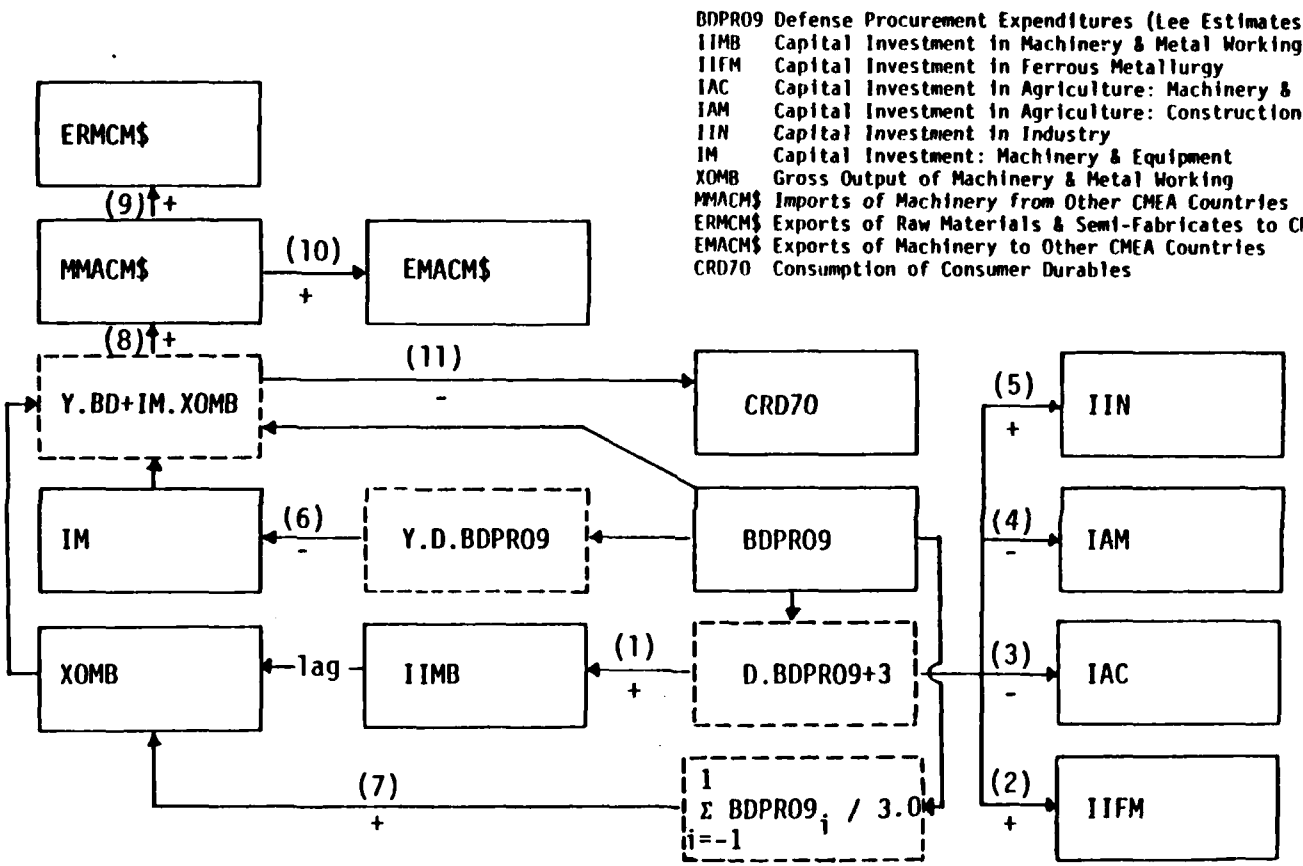

Figure 3.

Sequence of Defense Procurement Impacts

investment, it also may have the qualitative impact on productivity discussed above. In our production function for MB&MW we obtained a very good fit with an equation which indicated that some part of total productivity increases above that attributable to a linear time trend could be associated with the level of defense expenditures (7). In the area of foreign trade various specifications were tried. The best fit was obtained by relating the level of machinery imports from other CMEA countries with the "durables demand" variable (8). To pay for these imports, it may be--as indicated by the remaining two trade equations (9 & 10)-- that the Soviet Union must increase its exports of raw materials and machinery to these countries. Finally, this same defense variable has the expected impact on the level of consumer durables consumption (11).

Doubtless, other sequences could be found, and if the search were expanded, other areas of the economy related to activities in the defense sector. (This may be especially so if we were to introduce military manpower requirements or total military construction data.) The results presented here are adequate, however, to suggest that the type of defense variables we have defined can be made to give reasonable results when tested empirically with Soviet data for the past decade and a half.

Table 1.

(1) Investment in Machine Building & Metal Working

$$\frac{IIMB}{IIMB_{-1}} - 1.0 = 0.122\ D.BDPR09{+}3 - 0.076\ Q6567 + 0.337\ \left(\frac{ZPG^*/PII}{ZPG^*_{-1}/PII_{-1}} - 1.0\right)$$

(0.118) (5.27) (2.95) (2.87)

$R^2 = 0.669$ SEE = 0.037 DW = 1.92 Period of Fit: 1959-1972

IIMB	Investment in the Machine Building & Metal Working Branch
D.BDPR09+3	"Planned Procurement" Variable
Q6567	Dummy Variable for 1965-67
ZPG*	Gross Profits in the National Economy
PII	Industry Investment Deflator

(2) Investment in Ferrous Metallurgy

$$\frac{IIFM}{IIFM_{-1}} - 1.0 = -0.099 - 0.0522\ QFYP - 0.2115\ Q66 + 0.309\ D.BDPR09{+}3$$

(0.085) (1.26) (1.31) (3.38) (3.40)

$R^2 = 0.759$ SEE = 0.059 DW = 1.53 Period of Fit: 1957-1972

IIFM	Investment in the Ferrous Metallurgy Branch
QFYP	Dummy Variable for the Five Year Plan Cycle
Q66	Dummy Variable for 1966
D.BDPR09+3	"Planned Procurement" Variable

(3) Investment in Agriculture: Construction & Installation Work

$$\frac{IAC}{IAC_{-1}} - 1.0 = 0.205 + 0.227\ \left(\frac{IFAG^*9/PIA_{-1}}{IFAG^*9_{-1}/PIA_{-2}} - 1.0\right) - 0.072\ D.BDN^*9/PIWH70$$

(0.111) (4.65) (3.23) (1.32)

$$+ 0.539\ XAGDV - 0.185\ D.BDPR09{+}3$$

(2.94) (2.58)

$R^2 = 0.651$ SEE = 0.033 DW = 1.96 Period of Fit: 1960-1972

(Table 1 continued)

IAC	Investment in Agriculture: Construction & Installation
IFAG*9	State Budget Financing for Agriculture
PIA	Agriculture Investment Deflator
D.BDN*9/PIWH70	Growth Rate of Non-Personnel Defense Expenditures (Cohn Estimates) Deflated by Heavy Industry Wholesale Price Index
XAGDV	Deviation of Agricultural Output from Normal Output Level
D.BDPRO9+3	"Planned Procurement" Variable

(4) Investment in Agriculture: Machinery & Equipment

$$\frac{IAM}{IAM_{-1}} - 1.0 = 0.283 - 0.190 \left(\frac{IFAG*9/PIA_{-1}}{IFAG*9_{-1}/PIA_{-2}} - 1.0\right) - 0.421\ XAGDV_{-1}$$

(0.080) (7.53) (3.24) (2.96)

$$- 0.269\ D.BDPRO9+3$$

(4.60)

$R^2 = 0.876$ SEE = 0.032 DW = 2.30 Period of Fit: 1960-1972

IAM	Investment in Agriculture: Machinery & Equipment
IFAG*9	State Budget Financing for Agriculture
PIA	Agriculture Investment Deflator
XAGDV	Deviation of Agricultural Output from Normal Output Level
D.BDPRO9+3	"Planned Procurement" Variable

(5) Investment in Industry

$$\frac{IIN}{IIN_{-1}} - 1.0 = 0.466\ GPIN9 + 0.173 \left(\frac{ZPG*/PII}{ZPG*_{-1}/PII_{-1}} - 1.0\right) - 0.068\ Q6567$$

(0.079) (4.01) (4.14) (7.23)

$$- 0.038\ QFIN - 0.152\ D.BDN*9/PIWH70 + 0.045\ D.BDPRO9+3$$

(2.76) (6.78) (2.77)

$R^2 = 0.924$ SEE = 0.013 DW = 2.13 Period of Fit: 1958-1972

(Table 1 continued)

IIN	Investment in Industry
GPIN9	Planned Growth Rate for Centralized Investment
ZPG*	Gross Profits in the National Economy
PII	Industry Investment Deflator
Q6567	Dummy Variable for 1965-67
QFIN	Dummy Variable for the Construction Finishing Campaigns
D.BDN*9/PIWH70	Growth Rate of Non-Personnel Defense Expenditures (Cohn Estimates) Deflated by Heavy Industry Wholesale Price Index
D.BDP09+3	"Planned Procurement" Variable

(6) Total Machinery and Equipment Investment

$$\frac{IM}{IM_{-1}} - 1.0 = 0.0645 + 0.245\ GPIN9 - 0.281\ Y.D.BDPR09$$
$$(0.091) \quad (4.01) \quad (1.36) \quad (4.22)$$
$$+ 0.0787 \left(\frac{ZPG^*/PII}{ZPG^*_{-1}/PII_{-1}} - 1.0\right) - 0.051\ Q69$$
$$(1.53) \quad (2.57)$$

$R^2 = 0.689$ SEE = 0.019 DW = 2.33 Period of Fit: 1959-1975

IM	Total Machinery and Equipment Investment
GPIN9	Planned Growth Rate for Centralized Investment
Y.D.BDPR09	"Procurement Shift" Variable
ZPG*	Gross Profits in the National Economy
PII	Industry Investment Deflator
Q69	Dummy Variable for 1969

(7) Gross Output of the Machinery & Metal Working Branch

$$\left(\frac{XOMB + XOMB_{-1}}{XOMB_{-1} + XOMB_{-2}} - 1.0\right) - 0.521 \left(\frac{NMIMB}{NMIMB_{-1}} - 1.0\right) = 0.00087\ QT50$$
$$(0.060) \quad (1.25)$$
$$+ 0.365 \left(\frac{KMB}{KMB_{-1}} - 1.0\right) - 0.022\ Q6466 + 0.00064 \left(\sum_{i=-1}^{1} BDPR09_i/3.0\right)$$
$$(4.51) \quad (6.47) \quad (1.77)$$

$R^2 = 0.935$ SEE = 0.004 DW = 2.18 Period of Fit: 1962-1974

(Table 1 continued)

XOMB	Gross Output of the Machinery & Metal Working Branch
NMIMB	Employment in the Machinery & Metal Working Branch
QT50	Time Trend Dummy with 1950=1 and 1975=26
KMB	Capital Stock in the Machinery & Metal Working Branch
Q6466	Dummy Variable for 1964-1966
BDPR09	Military Durables Expenditures (Lee Estimates)

(8) Imports of Machinery from Other CMEA Countries

$$MMACM\$ = 4919.23 + 28911.3\ Y.BD+IM.XOMB - 5550.87\ \frac{PM1HUS9}{PM2HUS9}$$

(2947.2) (7.64) (23.44) (9.61)

$R^2 = 0.979$ SEE = 258.42 DW = 1.47 Period of Fit: 1960-1975

MMACM$	Imports of Machinery from Other CMEA Countries
Y.BD+IM.XOMB	"Durables Demand" Variable
PM1HUS9	Intra-CMEA Price of Machinery (Hungarian Imports)
PM2HUS9	Intra-CMEA Price of Raw Materials and Fuels (Hung. Im.)

(9) Exports of Raw Materials & Semi-Fabricates to Other CMEA Countries

$$\frac{ERMCM\$}{PM2HUS9} = -5.166 + 0.207\ YCMEA9 + 0.00404\ MMACM\$$$

(35.3) (2.38) (7.27) (6.00)

$R^2 = 0.992$ SEE = 1.388 DW = 2.14 Period of Fit: 1960-1975

ERMCM$	Exports of Raw Materials & Semi-Fabricates to CMEA
YCMEA9	Net Material Product of CMEA
PM2HUS9	Intra-CMEA Price of Raw Materials and Fuels (Hung. Im.)
MMACM$	Imports of Machinery from Other CMEA Countries

(10) Exports of Machinery to Other CMEA Countries

$$\frac{EMACM\$}{PM1HUS9} = -3.070 + 0.584\ \frac{MMACM\$}{PE1HUS9}$$

(13.62) (5.24) (32.00)

$R^2 = 0.987$ SEE = 1.063 DW = 2.35 Period of Fit: 1960-1975

(Table 1 continued)

EMACM$	Exports of Machinery to Other CMEA Countries
PM1HUS9	Intr-CMEA Price of Machinery (Hungarian Imports)
MMACM$	Imports of Machinery from Other CMEA Countries
PE1HUS9	Intra-CMEA Price of Machinery (Hungarian Exports)

(11) Consumption of Durables

$$\frac{CRD70}{ZD70} = 0.0541 - 0.0696\ Y.BD+IM.XOMB + 0.00636\ e^{(QT50/10.)}$$

(0.07) (6.79) (2.20) (10.32)

$R^2 = 0.982$ SEE = 0.0025 DW = 1.40 Period of Fit: 1958-1975

CRD70	Consumption of Durables
ZD70	Real Disposable Household Income
Y.BD+IM.XOMB	"Durables Demand" Variable
QT50	Time Trend Dummy with 1950=1 and 1975=26

4. A More Detailed Examination of Impacts on Investment

Green disaggregated total investment into centralized and decentralized forms, and each of these further by producing sector--construction/installation (C&I) work and machinery and equipment (M&E). He then examined the impacts of defense variables on these separate components and found several interesting relationships.[7] This investigation was repeated using th Lee estimates of defense procurement (in the forms described above). The results are summarized in Table 2. The explanatory variables again displayed rather systematic patterns:

(a) Planned growth rate of centralized investment[8]

This variable, obtained from the Annual Plan for Capital Construction, seems to predict well the movement of centralized investment in machinery and equipment. This tie then carries over to the growth of aggregates in which centralized M&E is a component--total centralized and total M&E investment. The failure of the planned growth variable to exhibit any impact on centralized C&I work is probably a result of the stronger explanatory power of the "planned procurement" variable in that equation.

(b) "Planned procurement" variable

As explained above, it was expected that in a planned economy future growth of defense procurement would be reflected in current levels of investment for capacity expansion in defense and defense related industries. Support for this was found in the estimated investment

GROWTH RATE CATEGORIES	SYMBOL (MEAN) PERIOD	CONSTANT	INVESTMENT PLANNED GROWTH	DEFENSE O & M	PLANNED PROCUREMENT VARIABLE	PROCUREMENT SHIFT VARIABLE	GROSS PROFITS	FINISHING* CAMPAIGNS	R^2	D.W.
TOTAL NEW CAPITAL INVESTMENT	GIT (0.084) 1958-72			-0.081 (1.67)	0.1311 (11.11)	-0.1529 (1.38)		-0.0495 (1.63)	0.604	1.80
TOTAL CONSTRUCTION-INSTALLATION	GIC (0.073) 1959-72			-0.0693 (2.06)	0.1306 (9.50)		-0.0645 (1.02)	-0.0556 (2.57)	0.752	1.98
TOTAL MACHINERY & OTHER	GIM (0.091) 1959-72	0.0645 (4.01)	0.2455 (1.36)			-0.2813 (4.22)	0.0787 (1.53)	-0.0512 (2.51)	0.689	2.33
TOTAL CENTRALIZED INVESTMENT	GICT (0.074) 1959-72		0.3262 (1.66)		0.0800 (2.82)	-0.1426 (1.88)	-0.0546 (1.04)	-0.0327 (1.77)	0.681	1.91
CENTRALIZED CONSTRUCTION-INSTALLATION	GICC (0.068) 1959-72				0.1209 (10.99)		-0.1184 (2.24)	-0.0349 (1.92)	0.686	1.79
CENTRALIZED MACHINERY & OTHER	GICM (0.091) 1959-75	0.0526 (2.69)	0.4784 (2.08)			-0.2942 (3.57)		-0.0443 (1.75)	0.617	1.82
TOTAL DECENTRALIZED INVESTMENT	GIDT (0.072) 1959-75	0.0621 (3.06)		-0.2556 (3.08)			0.4050 (2.85)	-0.0936 (2.74)	0.675	1.91
DECENTRALIZED CONSTRUCTION-INSTALLATION	GIDC (0.074) 1959-75	0.0767 (3.51)		-0.1181 (1.32)			0.3185 (2.09)	-0.1546 (4.20)	0.659	1.50
DECENTRALIZED MACHINERY & OTHER	GIDM (0.080) 1959-75	0.0438 (0.93)		-0.5208 (2.57)			0.6396 (1.84)		0.420	1.82

(Coefficient t-statistics are given in parentheses below their value.)

*Dummy variable for 1962,1969, 1973 for GIDT & GIDC and for 1969 only for all others.

Table 2.

Estimation Results for Components of Investment

functions for the machine building and metal working and the ferrous metallurgy branches. Here we see other dimensions of this impact. Due to the longer gestation period required for the creation of structures compared to equipment, it is not surprising that it is investment in C&I work where we find the impact most evident. And since the defense industry is under centralized control, the results of using the "planned procurement" variable to expain centralized investment are also as expected.

(c) "Procurement shift" variable

Our previous notions as to the disruptive impact on investment of abrupt changes in the growth of defense procurement are also strengthened by the results obtained. Since it is specifically the production of durables for M&E investment that is likely to be displaced in such cases, it is appropriate that this variable appears significant only in the equations for investment of this type. The fact that decentralized investment in M&E was found to be free of this response could be explained by the composition of such investment. It is likely that the types of investment goods for which decentralized funds are utilized do not draw upon the capacity needed for armament production.

(d) Growth of defense operations and maintenance expenditures

The present results correspond almost exactly with those obtained in Green's study. The impact is negative and is concentrated in decentralized investment of both M&E and C&I work.

(e) Growth of profits

Profits are a major source of funds for both centralized and decentralized investment. But while investment controlled at the enterprise level is dependent upon the profits of the enterprise, centrally controlled investment is supported by many other sources channeled through the State Budget. Thus the direct relation between growth in categories of decentralized investment and growth in profits is as expected.

What may not be readily understandable are the negative coefficients for this variable in the centralized investment categories. This may be explained as follows. In our investment equations no variable was introduced to represent shifts in the share of investment under the two forms of control which took place during the period under study. As part of the 1965 reform, it was planned for the decentralized share to increase, and enterprise profits were allowed to grow as a source of funds for this investment. Due to some "undesirable" results of the reform, these measures were modified in the early 1970s, with a resulting fall in profits and decentralized investment. This pattern is clearly evident in Figure 4, where from 1964 to 1970 the growth of both profits and decentralized investment is greater than centralized investment growth. After 1970 this is no longer the case. Thus the profit variable in the equations for

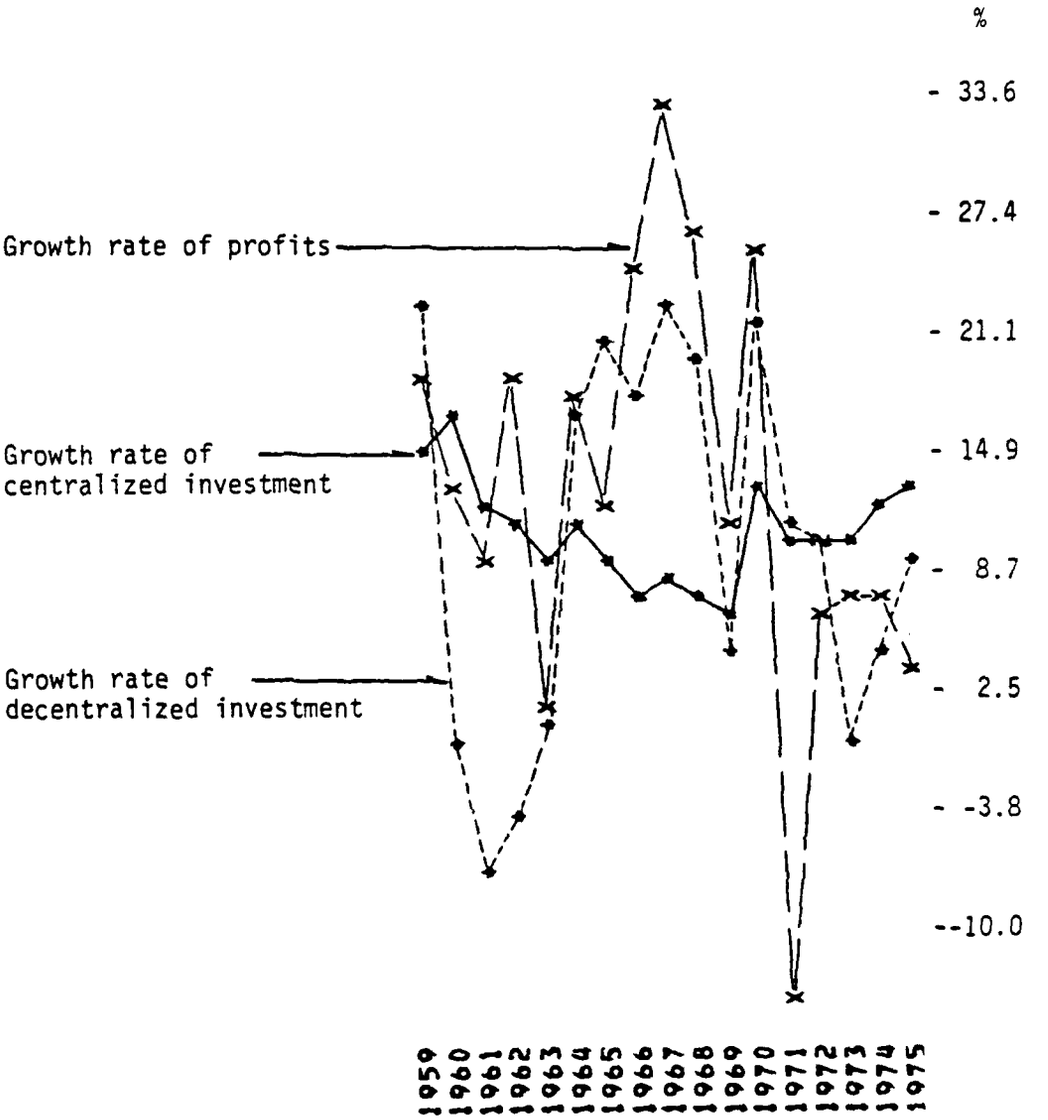
%
- 33.6
- 27.4
- 21.1
- 14.9
- 8.7
- 2.5
- -3.8
--10.0
Growth rate of profits
Growth rate of centralized investment
Growth rate of decentralized investment
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975

Figure 4.

centralized investment should be viewed as a proxy for the temporary shift away from this form of investment, and the negative sign is thus appropriate.

(f) Dummy variables for finishing campaigns

As described in the Green (1977) paper, there were several years in which there occurred campaigns to complete unfinished construction and to prohibit the initiation of new projects. Two dummy variables have been used in the investment equations to capture the effect of this bureaucratic intervention. For decentralized investment such campaigns occurred in the years 1962, 1969, and 1973. For centralized investment, only in 1969 does there seem to have been a similar degree of intervention.

Footnotes:

1. Green and Higgins (1977), Chapter 5; Green (1977)

2. Cohn (1976)

3. O.S.R. (C.I.A.) (1976); Lee (1975) 4. Green (1977)

5. The Lee procurement estimates are in constant (1970) prices. The Cohn data are in current prices, but were not deflated in Green's tests since Cohn's preferred deflator for this series is virtually equivalent to a constant deflator.

The procurement series used in this study and attributed to Lee is based on two series presented in Lee (1975): (1) a 1955-1966 series in 1955 prices; and, (2) a 1966-1975 series in 1970 prices. In each of these, the estimates for each year are given as a range. To use these data we took the mid-point of each year's range, and then deflated the 1955-66 series by the ratio of the two overlapping 1966 values. In his work Lee does not combine his estimates into a single 1955-75 series. His reasons for this are the absence of adequate information for properly adjusting the values of one series to correspond to the prices of the other, and the fact that the earlier series is thought to include some prototype and spece hardware expenditures not covered in the later series. These are real problems, and they are not, of course, overcome by our simplistic approach to combining the two. However, since the procurement variables in our applications are always expressed as some growth rate or ratio form,

the distortions involved are probably not significant, especially so when the approximate nature of the original estimates themselves are considered.

6. Cohn (1970)

7. Green (1977)

8. The determination of this series and its relationship to the budget data will be described in a forthcoming paper by Donald Green.

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